S. HRG. 100-602, Pt. 2

DEPARTMENT OF ENERGY NATIONAL LABORATORY COOPERATIVE RESEARCH INITIATIVES ACT

HEARING

BEFORE THE

SUBCOMMITTEE ON
ENERGY RESEARCH AND DEVELOPMENT

OF THE

COMMITTEE ON
ENERGY AND NATURAL RESOURCES
UNITED STATES SENATE

ONE HUNDREDTH CONGRESS

SECOND SESSION

ON

S. 1480

TO IMPROVE THE INTEGRATION OF UNIVERSITIES AND PRIVATE INDUSTRY INTO THE NATIONAL LABORATORY SYSTEM OF THE DEPARTMENT OF ENERGY IN ORDER TO SPEED THE DEVELOPMENT OF TECHNOLOGY IN AREAS OF SIGNIFICANT ECONOMIC POTENTIAL

MAY 11, 1988

PART 2

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S. 1480—DEPARTMENT OF ENERGY NATIONAL LABORATORY COOPERATIVE RESEARCH INITIATIVES ACT

WEDNESDAY, MAY 11, 1988

U.S. SENATE,
SUBCOMMITTEE ON ENERGY RESEARCH AND DEVELOPMENT,
COMMITTEE ON ENERGY AND NATURAL RESOURCES,
Washington, DC.

The subcommittee met, pursuant to notice, at 2:14 p.m., in room SD-366, Dirksen Senate Office Building, Hon. Wendell H. Ford, presiding.

OPENING STATEMENT OF HON. WENDELL H. FORD, U.S. SENATOR FROM KENTUCKY

Senator FORD. Today, ladies and gentlemen, the subcommittee is holding its third hearing on S. 1480, the Department of Energy National Laboratory Cooperative Research Initiatives Act.

Senator Domenici has been the driving force, without question, behind this legislation.

The purpose of this hearing is to receive testimony on the issue of technology transfer from the Department of Energy national laboratories. In particular, we want to hear the administration's views on a complete substitute for S. 1480. This substitute, Amendment No. 1627, was introduced by Senators Domenici, McClure and Bingaman on March 4, 1987.

S. 1480 is on the committee's agenda for markup, and I understand that negotiations between Senator Domenici and the administration have been underway. I hope we can be brought up to date on the state of those negotiations today so we might be able to move expeditiously with the markup.

We will also hear from staff of the Office of Technology Assessment on their views about the commercialization of the new high-temperature superconductors. This very promising new technology is a case study unfolding right in front of us in how we deal with commercialization in the United States.

The point of this legislation is to encourage transfer into practical use of the research carried out at our national laboratories. Currently this transfer does not proceed as rapidly or as smoothly as we might like. Perhaps this is because the laboratories have missions that do not give priority to technology transfer. But that may have to change. I congratulate Senator Domenici for his persistence in raising this issue for all of us.

I understand that the administration does not support S. 1480 or the substitute amendment that has been introduced. If the legislation is not perfect, neither is the situation in the national laboratories. The Japanese and other foreign competitors are giving us a national beating in the commercialization of new technology. We need to get back into that fight and in the middle of it very quickly. The national laboratories ought to be an important force on our side. As of today, they are not. So, I would like to see constructive suggestions from the administration about how to make this legislation workable rather than assurances that everything will be fine without legislation.

Senator FORD. And with that, before we call the first witness, I'd welcome Senator Domenici here and ask if he has any statement that he would like to make before we have Secretary Fitzpatrick.

STATEMENT OF HON. PETE V. DOMENICI, U.S. SENATOR FROM NEW MEXICO

Senator DOMENICI. Thank you very much, Mr. Chairman.

First of all, I have a detailed analysis with my set of reasoning on this issue that I will not read. I'll ask that you make it a part of the record. It has been made available to those in the audience who are interested in my detailed analysis of why we ought to do this.

Senator FORD. It will be included in the record in total.

Senator DOMENICI. With your permission, I'm going to try to take just three or four minutes to summarize why I think we ought to do something and do something quickly.

But first, I would be very remiss if I didn't thank you personally, Senator. You don't happen to have a national laboratory in your backyard. By coincidence of history, I happen to have two, not only two, but two of the three nuclear deterrent laboratories, and they are of special interest to me not only because they are there, but because they are the victims in my opinion of some very special rules which rules, again in my opinion, serve no useful purpose.

Having said that, I want to give just a quick analysis for the Secretary of why I think we should do something and do it quickly.

First of all, I rechecked my numbers. So, I will be closer to accurate than last time. There are actually more scientists under the control of your Department than any institution in the free world. The numbers, if I'm right, are scientists themselves, 15,000; support people bring that number to 23,000 to 25,000.

Now, there is no one around, no institution in the free world, that has that pool of talent. It is diverse. It is interdisciplinary, and those who think the scientists at Los Alamos only work on nuclear weapons, only have to go up there and talk to them. I mean, they have some of the world's greatest geneticists. They happen to be the center of the gene bank for the United States with reference to measuring and mapping the human genome. They invented the equipment which will be used for that when this country finally makes a breakthrough and maps the entire genetic structure of the human body. They have some of the greatest biologists in the world, greatest physicists, on and on.

And they work together, some in a university climate, some in a more business oriented climate like Sandia which is modeled after

AT&T. And then there is Livermore over in California, which is more modeled after a university structure, and I think we all know what that means.

Now, I want to draw a comparison for you, Mr. Chairman, and for this record. If all of that is the case, and if this world we live in is going to be a world of constant rapid technological change—and I believe it is. In fact, I can tell you, Madam Secretary, my prediction for you and for anyone that will listen to me is that in the next 25 years, we will make more scientific breakthroughs, basic breakthroughs, than we have in all of civilized history. And one of the reasons is that we now have these giant things called computers. And we tie them to the research mind of man, and it is inevitable that breakthroughs will occur exponentially.

The problem is that America used to have a lock on all that. We don't anymore. So busy out there in the world are those that learn from us working on the same premise and not subject to the same problems we have of utilizing our scientific base because we have the luxury of niching it. You could have business doing their thing, and that was wonderful; the universities doing theirs and that was great; and business doing theirs, that's fine; and the Federal Government doing theirs with a very special mission. I've come to the conclusion that we are no longer rich enough to do that, that we have to find ways to mesh that talent and create a synergy from it that helps America grow and brings things to the marketplace.

Now, this bill is the result, Mr. Chairman, of three years of effort and, I will tell you in all honesty, utter frustration. Everywhere we go we talk to private sector people and have hearings, and they say the laboratories of the United States Department of Energy in particular, Madam Secretary, those that are nuclear are useless to us. I've grown so sick of hearing it that I've called them to ask them what do they mean. I guess we coin a word now that is nicer than that, and it's that they are user "unfriendly." That's a nicer word. That really means we have rules, regulations and inhibitions, statutory and otherwise, that just don't permit the private sector to use them as they should.

Now, I want to give you one statistic and five quick points. Mr. Chairman, the Department of Energy uses a notion with some numbers in it of how well we are doing in the area of technology transfer and license agreements, and they are very proud to say that during a period of time there have been 27 start-up companies coming out of the labs and 200 license agreements to major companies. And if you read the paraphernalia of the Department—and pardon me, not in the pejorative, the propaganda of the Department used in its best sense. That is a very, very big positive statement.

Now, I would like to draw a comparison for you. Massachusetts Institute of Technology, one-tenth the size or less—and so that the Secretary will not jump me on this, with a primary mission of educating young people, not a primary mission of delivering to the American marketplace—most interesting, did almost exactly the same amount. They had about 26 or 28 start-up companies, right close to 200 license arrangements in the very same period of time. They come nowhere close to having 15,000 of America's greatest scientists with 8,000 or 9,000 support services and, might I add, the

most fantastic equipment in the world, which we have and they don't.

Now, if I had no other facts other than that, I would be very concerned about why. Now, remember, I said M.I.T.'s mission was not to transfer technology or license. As a matter of fact, they get pretty upset when you say why don't you do more. They remind us that they are an education institution. DOE reminds us. When we say get on with it, they say we're a mission-oriented set of laboratories. We have to maintain America's nuclear deterrent. I agree. But I think they ought to do as well as M.I.T., and if they did, they would have 10 times the statistics that they give as proof of their effectiveness. I think this is because America has to learn in this day and age how to use these resources that we didn't have to use in our past history.

So, I am suggesting, without losing our right to oversight, without your losing your right to fire a director of the national laboratories, that they ought to be able to contract uniformly, all of them, with the private sector up to $1 million for work. I'm suggesting that they ought to be able, without your approval in limitations, to exchange personnel with the private sector. If they exceed a contract by $1 million up to $10 million, which is the maximum, you can cancel it if you think it does not meet the mission of the laboratories. I think that would begin to move the exchange that we need with the private sector and use it.

We need to standardize the intellectual property system. It is very different from lab to lab. We need to update the intellectual property situation so as to recognize the proprietary values of data and software, and I will hear from the Secretary that you're busy doing that. And when we're all finished on all of these that you have regulations on, I will ask if you will submit the regulations in their entirety to this committee because I believe as soon as you put your writers to writing the regulations, we're right back in the muddle. Some of them are 54 pages long with reference to some of these issues, and they're going to be just as user unfriendly as if you didn't write them.

Now, I could go on. Beyond that, I think we ought to focus on some of the new technologies like the human genome, semiconductors. We've already done that in one of our authorizing bills, and we're moving in that front.

So, overall, while I have great respect for the Department and I'm somewhat aware of your testimony, I will only call to your attention that in this case the President of the United States in my opinion is way ahead of you all. If you read his executive order, to me it clearly indicates that we ought to be doing many of the things that are in this bill. I just don't believe, since he agrees, we agree, all kinds of people agree, we ought to leave it up to you, you and your Secretary who are doing a marvelous job. Secretary Herrington is moving dramatically in this direction. I think we ought to codify it and not leave any ambiguities around to change it from Secretary to Secretary.

So, I regret that reviewing your testimony you don't favor this. I only hope that you understand our sense of frustration over the lack of utility of such a fantastic American resource. And I for one have no intention of minimizing their capabilities to perform their

military mission for the United States. I am only convinced unequivocally that they can do that and help the private sector of America proceed ahead without losing any of their priority mission.

Thank you very much, Mr. Chairman. I look forward to her testimony and the others.

[The prepared statement of Senator Domenici follows:]

SENATOR PETE V. DOMENICI

U.S. SENATE COMMITTEE ON ENERGY AND NATURAL RESOURCES
SUBCOMMITTEE ON RESEARCH AND DEVELOPMENT

HEARING TO CONSIDER S.1480,
THE DEPARTMENT OF ENERGY NATIONAL
LABORATORIES COOPERATIVE RESEARCH INITIATIVES ACT

MAY 11, 1988

Mr. Chairman, I want to thank you for holding today's hearing, which continues consideration of S.1480, legislation that I believe is essential to America's future.

The topic of this hearing may sound quite boring to many in the audience. That topic is whether the Federal Government should alter how the transfer of technology is managed once that technology is developed within one of our National Laboratories.

I am convinced that the real heart of this issue --- indeed the heart of what the 100th Congress should focus its attention on --- is America's future.

What do we want American to become? How should we grow in order to prosper?

What are our strengths, and how should we build on them?

What are our weaknesses, and how should we overcome them?

Each of those questions holds great importance to our future? And if we fail to address them, and address them aggressively, our future may become increasingly bleak.

Let me start by stating a few very basic facts and assumptions that I believe you will agree with:

--- Knowledge is America's future.

--- Scientific progress is America's future.

--- More scientific breakthrough occur here than anywhere else in the world.

--- America issues more patents than any other nation.

--- We spend freely on science. The United States Government spends more for research and development --- $117 billion according to Budget--- than the next four Western industrialized countries combined; Japan spends $35 billion, West Germany spends $16 billion, France spends $13 billion, and the United Kingdom spends $12 billion.

--- The largest single scientific organization in the Free World, with more scientists on the payroll than any other organization, is the U.S. Department of Energy, working through our system of national laboratories.

Those, Mr. Chairman, are a few facts about America's strength.

We have greater capability --- from human brainpower to computer power --- than any other society.

And as the pace of inventions and scientific advancement accelerates in the next decade --- as it inevitably will --- how will we take advantage of those strengths?

In my view, one of the easiest and most efficient ways would be to tackle our weaknesses, to cut them out, to lessen those weaknesses and thereby increase our strengths.

What are those weaknesses that I have mentioned? Clearly the need for greater math and science teaching in our schools is one; we're doing something about that.

This bill, S. 1480, focuses on what I am convinced is is major American weakness in our scientific progress. It is the barrier we have imposed that locks so much science inside the walls of those laboratories.

We as a nation are simply failing to use that single largest pool of scientific talent, that army of brilliance that America has stashed away in our national labs.

Can you think of another nation, another society, that would be so stupid as to say: You scientists continue working, but no matter what you invent, no matter what you discover, don't tell us about it unless it has to do with your legislated mission. Don't let American industry use that knowledge to be more competitive in the world.

The work the national lab scientists are doing now is vital to America and its defenses. In no way would I ever suggest deflecting that.

But there is one thing that I, as a layman, know with certainly, and it is this: Scientific breakthroughs in one field often occurs as a result of research in another.

Change is the way the world works. Change is the key to the future. And, frankly, if we fail to change the way the system of national laboratories does business, making them more "user friendly," we can expect the change in the rest of the world to leave us behind. We will become a nation choking on the dust of our competitors.

I believe that would be a disaster.

If we, as a nation, are to continue to be competitive, we must allow that great reservoir of scientific talent in the labs to interact with the rest of the scientific community.

That is what S. 1480 is all about. That is what we, as a Government must encourage, not discourage.

Let me cite an example that I believe underlines the case for legislation that will insist that the labs become a greater partner in America's drive for excellence, a partnership between the 23,000 scientists, engineers and support staff at the labs and the rest of America's research and development community.

DOE must be directed to delegate to the laboratories modest authorities so that the labs can enter into cooperative research and development agreements to solve problems and help industry so that it is U.S. industry that brings the lion's share of new products to the marketplace.

I conducted my own survey at the President's Conference on Superconductivity. There were about 400 research and development business representatives in the audience and only one had ever been able to obtain useful scientific technology from a National Laboratory.

At an Armed Services hearing in Albuquerque, New Mexico, a industry witness brought nine separate contracts, warrants, license, and royalty agreements--standing nearly two inches high in all--that had to be negotiated with one of the weapons labs, the lab contract manager, and with DOE before the lab could accept money from a particular company to conduct sponsored research.

DOE's Energy Research Advisory Board recently completed an industry survey and found only a few companies received enough technology from DOE to make any difference to their companies.

The conclusion was that the DOE supported activities have little impact on the operation of these and other large and small companies and therefore, do not contribute to competitiveness.

The clear consensus among the Energy Advisory Board, and other experts, is that getting anything from one of the laboratories is rather like climbing through a second story window, without a ladder.

S. 1480 doesn't provide a ladder. But it does give American companies the right to walk in the front door, something they don't have know, thanks to the way DOE operates.

DOE will tell you that the bill goes too far. But DOE also believes that the President went too far in his executive order, and that Congress went to far when it passed the Bayh-Dole legislation dealing with intellectual property.

What does the law of the United States say? It says this in title 18:

> It is the policy and objective of the Congress to use the patent system to promote the utilization of inventions arising from federally supported research or development; to encourage maximum participation of small business firms in federally supported research and development efforts; to promote collaboration between commercial concerns and nonprofit organizations, including universities; to ensure that inventions made by nonprofit organizations and small business firms are used tin a manner to promote free competition and enterprise; to promote the commercialization and the public availability of inventions made in the United States industry and labor; to ensure that the Government obtained sufficient rights in federally supported inventions to meet the needs of the Government and protect the public against nonuse or unreasonable use of inventions; and to minimize the costs of administering policies in this area."

That seems fairly clear. But try to use it!

DOE's regulations regarding this provision run to 52 pages. That is what is known as red tape.

In the September 1987 issue of Business World, it was reported, "The DOE is particularly hostile to industry-directed research. It has refused to give the labs authority to license patents to companies--a step that industry considers crucial for making the technology accessible. The department's policy of reviewing every

application for a patent or license case-by-case, industry complains, is too much trouble and takes too long--anywhere from six months to several years--to pass through the labyrinth of DOE bureaucracy....Bryan Siebert, DOE director of international security, admits, "I would err on the side of reviewing practically everything, even if it involves delays."

The current law and DOE's policies are anything but uniform. They simply scare industry away. Under the current regulatory scheme, ownership of intellectual property depends on where (which Laboratory) the work was done.

It makes no sense that Argonne National Laboratory receives all intellectual property rights unless DOE specifically withholds them. Until recently, DOE kept all intellectual property rights at Los Alamos unless the University of California specifically petitions for them.

The new University contract creates three categories depending on the funding source of the invention. Some Los Alamos will get automatically; others DOE will keep regardless; and a large segment fall into a general category for review.

Why would any businessman want to become involved in a mess such as that?

Why should an invention created at Argonne be owned by Argonne, but one created at Sandia belong to DOE?

S. 1480 would move toward uniformity, while recognizing that the Defense laboratories have a special mission.

Several of the directors of the weapons laboratories have testified on this bill and has said that technology management powers envisioned in this bill will in no way jeopardize their primary defense mission.

The Energy Research Advisory Board (ERAB) of the Department of Energy has issued several studies on ways to enhance the laboratory-industry relationship. Among the key recommendations made in 1982, 1985, and in their most recent report, are the following:

Allow industry to do more reimbursable work with industry. Allow labs to enter into cooperative agreements up to a specified level without prior DOE approval. Implement liberalized patent and copyright policies. Encourage personnel exchanges with industrial firms. Develop a policy on cost-sharing with industry.

S. 1480 accomplishes each of these recommendations.

Just last year the President issued Executive Order 12591 on Facilitating Access to Science and Technology, implementing the Technology Transfer Act of 1986. This executive order requires Federal agencies and laboratories to assist universities and the private sector in moving knowledge from research labs into development of new products and processes.

Laboratory directors were charged with facilitating technology transfer to the marketplace. This order cited the need to create cooperative research and development programs, and license, assign, or waive intellectual property rights to technology developed in the labs, and, initiate scientific personnel exchange programs.

S. 1480 was written to implement the President's policy since DOE has told this Committee that it cannot fully comply with the executive order because of inconsistencies it its organic laws. S. 1480 removes those inconsistencies.

The recommendations and policies laid forth over the past decade are very clear, and reiterate the same objective over and over again to improve the link between Federal laboratories' technology base and that of U.S. businesses.

A March, 1988 GAO report cited the major constraints to technology transfer faced by the Federal laboratories. These included:

Public dissemination of computer software, creating disincentives for marketing such products; lack of proprietary research capability makes businesses less inclined to enter into collaborative research and development agreements; uncertainty and delay in gaining title to inventions at DOE laboratories due to waiver request process; and unnecessary complex procedures.

Our national laboratories hold great potential for helping American industry. But technology transfer has. at best, been a secondary mission. S.1480 makes this a part of their official mission, while not detracting from the labs primary missions.

Current initiatives far too often fall short of streamlining the procedures. Too frequently, we have heard that it is a step backward. Recent software policy has been cited by at least one company as creating such risks for business that investment would not make prudent business sense.

The extensive audit and oversight authorities given to the Secretary of Energy, the Comptroller General and the

Department of Energy Inspector General remain in place to carefully monitor, audit and oversee the Laboratories as they engage in this new technology race.

Mr. Chairman, while I have been forced to explain some of the rather minute details of this bill, in closing I want to return to its basic thrust.

That thrust is a very simple one: It is a thrust to open the doors to our future, to allow the greatest scientific nation in the history of mankind to use and employe that knowledge to our own benefit.

Senator FORD. Thank you very much, Senator Domenici.

Senator Bingaman, do you have a statement you would like to make?

Senator BINGAMAN. Well, let me put a statement in the record, Mr. Chairman.

Senator FORD. It will be included in the record in total.

[The prepared statement of Senator Bingaman follows:]

STATEMENT BY SENATOR JEFF BINGAMAN (D-NM)

DOE National Laboratory Cooperative Research Initiative Act

Hearing of the Energy and Natural Resources Committee
May 11, 1988

Mr. Chairman, I would like to thank you for calling this hearing. I would also like to commend my colleague, Senator Domenici, for his original bill S. 1480 and his substitute amendment #1627, which I am pleased to co-sponsor.

Technology Management

The heart of the substitute amendment is Title IV -- Technology Management at the Department of Energy National Laboratories. This title reforms the technology transfer and management system of our DOE national labs.

Cooperative research by and technology transfer from our national laboratories is vital to our quest to improve both our national economic competitiveness and local economic development. In New Mexico, we have long viewed the national labs as an potential catalyst to economic growth. Our state

was first in the nation in Federal R&D spending per capita in 1985 and fourth in the nation in total Federal government expenditures per capita for fiscal year 1986. And we lead the nation in R&D expenditures as a percent of personal income.

Last month, I held a hearing of the Joint Economic Committee in New Mexico on the issue of technology transfer and local economic development. At that hearing, we heard about the problems of technology transfer from local economic development officials, entreprenuers and representatives from universities and the national labs. There was wide spread agreement among the witnesses that our National Laboratories need greater flexibility in their technology management programs.

At that hearing, we also heard from Mr. Steven Lazarus, President of the ARCH Development Corporation -- a technology transfer consortium between Argonne National Laboratory and the University of Chicago. His testimony was an excellent example of how successful technology transfer can work and how a de-centralized system should operate. As I understand it, part of the ARCH contract allowing for local screening and assignment of patent rights is being used as a model for other DOE lab contracts. I would be interested in hearing

from our witnesses how that process has worked and how quickly it is being extended to other laboratories. I believe that this is an excellent example of the type of concrete action we can take to expand the technology transfer capabilities of our national labs.

However, it should be noted that our efforts to improve technology management in our National Laboratories and facilitate technology transfer is only part of the task. Better technology management and transfer will not be effective if our economy lacks the ability to turn the technology created in the labs into commercially useful products. It is not enough to simply transfer technology out of the labs. We must also be concerned with where that technology goes. To benefit from technology transfer in our national and local economy, we must have a strong technological and entrepreneurial infrastructure to take that technology and turn it into products and jobs. As we seek to strengthen the ability of our national labs to transfer technology, we must also work to strengthen the overall ability of our economy to develop and commercialize new products and processes.

Future Direction of the National Laboratories

The substitute amendment to S. 1480 goes beyond technology transfer and management activities. It also attempts to chart a new direction for our National Laboratories. This is especially important for the national labs in New Mexico. Last November, I held a hearing of the Defense Industry and Technology Subcommittee on the future of DOE's Nuclear Weapons Laboratories. As we look to the future, I believe it is clear that nuclear weapons research will become a less and less important mission of these labs. Yet, as witness after witness at the hearing pointed out, it is important that we take advantage of the tremendous scientific and technological capability at these facilities. This bill is an important step in creating a new role for all of our National Laboratories.

One particular focus of this bill is semiconductor technology. It should be noted that the Armed Services Committee's Subcommittee on Defense Industry and Technology, which I chair, has devoted a great deal of attention to the problems of the semiconductor industry. In last year's Defense Authorization Act, we set up a framework for government participation in SEMATECH - the Semiconductor Manufacturing Technology Institute. At that time, we also incorporated many of provisions of Title III of the

substitute amendment to S. 1480 -- the Semiconductor Technology Manufacturing Excellence Initiative -- into the Defense bill. It is, and was, I believe, completely consistent with the work of Defense Industry and Technology Subcommittee on SEMATECH.

Conclusion

Again, I would like to thank the Chairman for calling this hearing and complement my colleague, Senator Domenici, for introducing this bill and amendment. It is an important step forward in harnessing the technological resources available in our National Laboratories for our economic growth and development. I look forward to hearing the testimony.

Senator BINGAMAN. I would compliment you for having the hearing and, of course, compliment Senator Domenici on his bill which I'm pleased to cosponsor. I do think this is a crucial issue for the country and for our state. I look forward to the testimony.

Senator FORD. Thank you very much, Senator.

Madam Secretary, with all this onslaught, I know you're ready to defend yourself, which you always do adequately. Hopefully we can arrive at some kind of agreement so we can get off of this path. So, we're delighted that you are here today and look forward to your testimony.

STATEMENT OF DONNA R. FITZPATRICK, ASSISTANT SECRETARY, CONSERVATION AND RENEWABLE ENERGY, DEPARTMENT OF ENERGY

Miss FITZPATRICK. Thank you, Mr. Chairman. I do have a longer statement for the record, and I'd like to make a brief summary of it.

Senator FORD. It will be included in the record, and we'll appreciate brevity.

Miss FITZPATRICK. Needless to say, I listened with great care to Senator Domenici's onslaught waiting for him to say something I really disagreed with. And it didn't happen.

Senator FORD. Maybe we've got an agreement, Pete. We don't need you to testify. [Laughter.]

Miss FITZPATRICK. I think we fully share the Senator's goals, and it's a question of discussing the best means to achieve those goals.

At any rate, we do appreciate the opportunity to appear before the subcommittee today to discuss our technology transfer and laboratory-university-industry collaborative efforts in the context of S. 1480 and the amendment. We very much appreciate the willingness of the committee to consider our views on the bill and the very constructive efforts that have already been made to accommodate our concerns. We believe that it is important that this type of dialogue continue.

The goal of S. 1480 is to foster improved collaboration between universities, private industry and the national laboratory system of the Department of Energy so as to speed the development of technology in areas of significant economic potential and thus improve our Nation's economic competitiveness. The Department fully shares this goal and we are already taking significant steps to seek its achievement. A number of actions have been taken very recently in this respect, and I would like to take this opportunity to mention just a few of them.

Two task forces with Department-wide representation have recently conducted a review of the Department's intellectual property activities and policies and analyzed possible options for encouraging private sector collaboration in implementing the superconductivity initiative. As a result, we have recently completed and implemented a new policy for copyright of software developed in the course of research by the Department's laboratory contractors and made progress toward the completion of a rulemaking which will permit the Department's for-profit laboratory contractors to obtain patent rights to whole classes of inventions without the ne-

cessity of case-by-case approval by the Department. The not-for-profit laboratory contractors already enjoy this right.

As a result of the deliberations of the task force on superconductivity, three DOE national laboratories were recently designated by Secretary Herrington as superconductivity pilot centers. The centers will be located at Argonne National Laboratory, Los Alamos National Laboratory, and Oak Ridge National Laboratory. The pilot centers will test innovative concepts in laboratory collaboration with industry, as well as new approaches to the transfer of intellectual property rights to industry.

In a separate initiative, the Acting Assistant Secretary for Defense Programs, Mr. Troy Wade, has commissioned the development of a defense programs technology utilization plan which addresses the ways to facilitate and accelerate technology transfer to and utilization by U.S. industry of developments in the laboratory and enable the weapons laboratories and production facilities to participate more fully in the departmental initiatives without infringing upon their important national security mission.

It is important to note at this point that these initiatives are moving ahead expeditiously. However, the innovative nature of some of the efforts requires deliberate planning and implementation procedures to assure successful collaboration between the national laboratories, universities and industry.

Just as there are many types of collaborative and cooperative agreements which already exist among these parties, there are also significant differences among the laboratories themselves, especially between defense laboratories and energy research laboratories. Our goal is to undertake these initiatives with the view of obtaining as much uniformity throughout the Department as is possible so as to streamline and make predictable to industry the ways in which they can collaborate with the laboratories.

As we continue our discussions of S. 1480, this diversity is one factor which must be taken into account. In addition, we have several guiding principles which we believe are important to our discussion of the bill. The authority of the Secretary to manage government funds and property must be retained while at the same time providing for expeditious approvals of collaborative R&D agreements and transfer of intellectual property rights. Intellectual property which has commercial value should be transferred to the party to an agreement which is most likely to commercialize it, providing that national security information can be protected from unauthorized dissemination.

The government should retain adequate rights to technical data to permit scientific discussion and development of derivative works. The integrated nature of the national laboratory system should not be impaired. And the national laboratories should serve as resources to industry, not as competitors.

We are also concerned that we should not permit a laboratory to retain title indiscriminately on all work done at the lab and thereby put it in a position to prevent the transfer of title to a cost sharing industrial partner.

We need also to prevent the creation of potential conflicts of interests that could arise from allowing laboratories to decide whether Freedom of Information disclosures should be made, and we

need to protect the needs of individual U.S. private sector researchers to share in technical data in their areas of research.

Also, we should not require that the government pay directly or through a tax on laboratory programs for the costs of obtaining and protecting intellectual property rights in laboratory-owned inventions and computer software. Such a requirement could subject the government to great expense in patent infringement suits and other litigation concerning intellectual property over which the Department could have little or no control.

Mr. Chairman, we appreciate the very constructive dialogue that we've had with the committee so far on this bill, and we look forward to continuing our discussions in the same spirit. I'll be happy to answer your questions at this time.

[The prepared statement of Miss Fitzpatrick follows:]

STATEMENT OF

DONNA R. FITZPATRICK

ASSISTANT SECRETARY FOR

CONSERVATION AND RENEWABLE ENERGY

BEFORE THE

SUBCOMMITTEE ON ENERGY RESEARCH AND DEVELOPMENT

OF THE

COMMITTEE ON ENERGY AND NATURAL RESOURCES

U.S. SENATE

MAY 11, 1988

Mr. Chairman and Members of the Subcommittee:

It is a pleasure to be with you to discuss the technology transfer efforts of the Department of Energy (DOE) and S.1480, the National Department of Energy Laboratory Cooperative Research Initiatives Act.

The Department fully supports the goal of S.1480 to improve cooperation among universities, industry, and the national laboratory system. Secretary Herrington has often emphasized the Department's commitment to effective technology transfer, research in superconductivity, further understanding the human genome, and laboratory support for semiconductor research. However, the Department has serious reservations about this bill, not because of its support for research on superconductivity, the human genome or semiconductors, but because a major consequence of this bill would be a transfer of important governmental authority from the DOE to the national laboratories. Passage of this bill will abrogate existing Congressional and Executive responsibility and accountability for the use of public funds and management of government programs. Changes of this magnitude are not needed to accomplish the objectives of the bill. The Department should transfer research results and intellectual property rights into the private sector, but the Department should not give up its existing review and management of laboratory activities.

Through cooperative research, our goal is to accelerate the commercialization of technology developments resulting from research in national laboratories. The record of the Department and its laboratories is certainly in line with the goal of the bill to work with universities and industry to enhance the

science and technology base that supports industrial development. Historically, DOE laboratories have developed the technological base for entire new industries, such as nuclear power and nuclear medicine, as well as making major advances in supercomputers and precision machining and engineering.

Many technologies have been transferred to the private sector covering a wide range of technical solutions. Some specific technologies that have been transferred from DOE laboratories to the marketplace which reflect this diversity are a cell separator that aids in cancer treatment, a diamond-tipped drill bit for oil exploration, and a solar heat collector system to provide inexpensive hot water to industry. Although very different, each of these technologies resulted from Federally-sponsored research in DOE laboratories, and each crossed the traditional boundaries separating government, industry, and the academic community as it moved into the commercial marketplace.

The Department's impressive record in technology transfer continues to grow. Let me cite just a few statistical examples. This year, scientists and engineers at DOE laboratories received 30, or nearly one-third, of the IR-100 Awards presented by Research and Development Magazine annually for the most significant developments in technology products, processes, and materials with market potential. Since 1981, the number of industrial users participating in experiments at the major DOE user facilities has nearly tripled. In 1987 over 1,600 users took advantage of these experimental facilities resources at the laboratories. Over $118 million in research and development was performed by our laboratories directly for industry. In addition to that effort, the

national laboratories participated in 57 collaborative projects with industry representing over $11 million worth of research and development. The number of new companies that were formed based on DOE laboratory technology has increased five-fold since 1981, with over 90 companies formed since 1985.

In a recent example of one method used to transfer technology, the Department waived its patent rights to a DOE process developed to remove nitrogen oxides from the exhaust gases of engines and furnaces. The process, which may have commercial applications for cleaning combustion exhausts, is called RAPRENO$_x$. It was invented at Sandia National Laboratories-Livermore and received a 1987 IR-100 award. The inventor has since left the laboratory, formed his own company, and intends to market his innovation.

The Department has consistently supported technology transfer initiatives and efforts aimed at reducing institutional barriers to the transfer of technology from its laboratories. Numerous improvements have been made in recent years, including providing more flexibility for laboratory staff to consult for industry and developing class waivers for patents originating from user facilities and work-for-others agreements. A computer software policy to allow contractors to copyright and license software has been finalized recently, and will be issued as an instructional letter to the Department's contracting officers. Standard contract language is being prepared and we expect our first contract implementing this policy to be signed within a few weeks. Significant progress has been made to provide DOE's nonprofit contractors with the right to elect to retain patent rights in all areas, except defense and other sensitive programs. To date, contracts for 11 such laboratory contractors have been modified. In the past year DOE laboratory

contractors have retained title to at least 162 inventions, which is five times the number of any previous year.

DOE is now required by law to process waivers on the defense-related exceptions within 150 days. For the for-profit contractors, the Department has developed a proposed rule for class patent waivers that is currently under Executive Office review, consistent with rulemaking procedures.

There are several recent examples of improvements in DOE technology transfer through the licensing of technology developments to interested users. In 1987, the DOE laboratories issued 37 licenses for DOE developed technology. Several of the laboratories are establishing adjunct organizations to license new technology to interested users. An example of such an organization is ARCH, at Argonne National Laboratory, which has now issued two licenses. Already of commercial importance are the ORNL-developed, whisker-toughened ceramic composites, which have been licensed to industry for application in cutting tools and parts exposed to heavy wear. They can operate at ten times the speed and last seven times as long as conventional materials.

We expect the Department's solid record of performance in technology transfer to continue to grow, aided in part by new initiatives aimed at promoting increased cooperation among Federal agencies, universities, and industry. It is the Department's standard operating procedure to carry out non-defense research activities in conjunction with industry, with cost-sharing wherever possible, and industry involvement from the inception of research projects. This involvement of industry in both sharing the cost and in assisting in the planning and execution of research assures that the research which is

conducted is of value to industry and that industry is fully informed of the results of the research. Of note among these initiatives is the President's April 10, 1987, Executive Order No. 12591 on Facilitating Access to Science and Technology. The overall thrust of the Executive Order is to ensure that all Federal agencies and laboratories assist universities and the private sector in broadening the technology base by moving new knowledge from the research laboratory into development of new products and processes. It has provisions for establishing consortia among laboratories, universities, and industry. The Department's new policies with respect to intellectual property and its continuing efforts to improve its procedures will carry out the mandate of E.O. 12591.

Recently, the Department has also taken steps to improve laboratory/university/industry interactions which would accomplish most of the objectives of the bill. As an example of one such step consistent with DOEs national security responsibilities, the Assistant Secretary for Defense Programs is exploring the development of a program for identifying technology transfer mechanisms and incentives that would accelerate commercialization. We believe that Defense Programs is a prime source of valuable applied technology. It also is a national asset in the management of industrial technologies whereby advances in new technologies in one field spur advances in another. We are optimistic that the outcome of this effort will significantly enhance the technology transfer efforts of the weapons laboratories and perhaps contribute to U.S. competitiveness. We think we can develop a greater sensitivity and responsiveness on the parts of the national laboratories carrying out DOE's defense programs with U.S. industry. Our efforts so far indicate this can be done quite compatibly with the labs' vital

national security mission. Critical to this initiative is the perspective that these labs should serve as resources and partners to U.S. industry, not competitors. These steps will allow DOE and the labs to grow in our understanding of the needs of industry while maintaining the central mission of the laboratories. We plan to keep the Congress fully apprised and to seek advice as we pioneer in this new and we believe very fruitful area.

COMMENTS ON S.1480

As I noted earlier, the Department agrees with the goal of S. 1480 to improve the integration of universities and private industry and the national laboratory system. However, this bill would bring about a fundamental change in the relationship between government and its national laboratories and we strongly object to this change. The longstanding DOE/ERDA/AEC policy, based on the Atomic Energy Act of 1954, is that the laboratories will not compete with private industry and will undertake work for others only when the facilities are available, the work does not interfere with DOE programs, and the work will not create a future detrimental burden on the laboratory or the Department. Furthermore, as part of the DOE complex, these Labs are also exempt from certain regulatory requirements. Passage of this bill could seriously jepardize this important distinction. This policy requires government review and control of laboratory activities. This bill would allow the laboratory directors who are not government employees to commit government funds without prior government review. The national laboratories would have reduced accountability to the Congress, the Executive branch, the taxpayer and the electorate for the expenditures of public funds.

This bill would result in a fundamental departure from sound government management practices that exist today. In order to accomplish its mission, it is essential that the Department retain an effective program management role in the operation and review of its laboratories.

The bill, as amended by Senator Domenici's substitute, gives directors of national laboratories (i.e. contractor personnel) the authority to enter into Government funded "cooperative research and development agreements" without approval of DOE (for agreements not exceeding $1,000,000) or with only a 30-day approval period (for agreements valued at $1,000,000 to $10,000,000). Under this authority the contractor operating the laboratory would be in a position to perform research and development work for private parties at Government expense. Laboratory contractors must not have the discretion to commit public funds unilaterally without DOE approval. Such a situation could cause many problems. For example, funds for research to be carried out in any given year are proposed, appropriated, and made available as a part of the budget process. This process cannot accommodate unilateral commitments made by laboratory contractors which would abrogate both the appropriating authority of the Congress and the management responsibility of the Department. Such authority could subject the laboratory and the government to liability for patent infringement and trade secret violations for activities under agreements over which DOE has no control or review.

The bill calls for a cooperative program of research on enabling superconductor technology and practical applications of superconductor technology involving one or more national laboratories; the establishment of

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cooperative research centers for these efforts at national laboratories; the exchange of personnel with industry as part of this program; and making DOE facilities available to participants in the program on a cost-reimbursable basis. These efforts are already underway, including the operation of special centers for superconductivity research at Argonne National Laboratory, Lawrence Berkeley Laboratory, and Ames Laboratory. As part of the President's Superconductivity Initiative the Department is pursuing additional means of linking the Nation's capabilities for generating scientific and technological innovations to its capabilities for commercial activities. The Department is already working with laboratories and interested industry to establish three Pilot Centers for collaborative research on high-temperature superconductors. The Department has just announced the funding of 15 new projects in high temperature superconductivity. The projects will require the laboratories to establish research teams with universities and industry. Additional legislation is not necessary to accomplish these objectives of the bill. We particularly oppose providing special rules for the antitrust treatment of cooperative research and development agreements that would be created under both S.1480 as introduced and the Domenici substitute. The National Cooperative Research Act of 1984 already provides protection against treble damage exposure for certain joint research and development projects, and the Administration's Superconductivity Initiative would expand that coverage to certain joint production agreements as well. We oppose giving special antitrust treatment to only a particular class of research and development agreements.

The bill also calls for various initiatives dealing with human genome and semiconductor research and development, which were addressed in our statements

during the September 15th and 17th hearings. The Department believes that existing coordination mechanisms are working effectively to achieve our goals in the genome initiative and are meeting the objectives of the bill. With regard to the proposed National Advisory Panel on Human Genome, we believe that there are existing mechanisms in place which will ensure interagency coordination and effective policy guidance. With regard to the semiconductor technology manufacturing initiative, the Department already is involved in similar initiatives and semiconductor research is already funded sufficiently through Sematech.

While we support efforts to provide for more uniform treatment of rights in intellectual property resulting from the Department's research and to more fully implement Executive Order 12591, we cannot support the intellectual property provisions of S.1480. The intellectual property provisions would vest ownership of intellectual property rights indiscriminately in the laboratories rather than the government or other contracting parties. This could actually hinder the commercialization of some technologies by preventing industry participants in cooperative agreements from obtaining these rights. This could have the unintended result of causing private sector firms to be reluctant to participate in cooperative research under these conditions. This also could subject the laboratory and the Government to liability for patent infringement and trade secret violation. The better way would be to vest intellectual property rights in the industrial participant who cost-shares the research. To make another constructive recommendation, we would suggest that conflict of interest provisions governing technology transfer activities be statutorily mandated. We have difficulty negotiating these without such a mandate. Some control is needed over situations where laboratory personnel

have influence in committing Federal funds to perform research for private parties who may make royalty payments to the laboratory , especially if such payments will be shared by the laboratory personnel. Ownership of rights in technical data as provided for in the bill requires further specificity to assure that the needs of researchers to share such data can be met, while supporting the commercial use of such data as expeditiously as possible and retaining an effective Federal program management role.

There appears to be a great deal of confusion associated with the Department's implementation of provisions for nonwaiver of rights to contractors under "exceptional circumstances". The class waiver is an "automatic" waiver of rights to our contractors. The Department's claim of exceptional circumstances only prevents "automatic" election by the contractors. The bill provides for withholding rights altogether to classified or sensitive inventions. It is not the Department's intent to necessarily withhold rights altogether in such instances, only to ensure that a patent filing does not publicly disclose technology of a classified or sensitive nature in contravention of other statutes and Department responsibilities. The withholding of export controlled technology from "automatic" waiver is a method for identifying technology requiring sensitivity review prior to patent filing and public disclosure. While we are saying, in effect, that that which is <u>not</u> export controlled is <u>not</u> sensitive, the reverse does not necessarily follow. The sensitivity has to be determined. The Department is currently working with the field to develop guidance to enable our contractors to conduct this review for any form of public release. There may be some cases

in which rights to classified or sensitive inventions can be transferred to contractors. In those instances we expect to facilitate the transfer of rights in a manner consistent with the Department's responsibilities to protect classified and sensitive technology from public disclosure.

The Department strongly objects to the requirement for DOE to pay the costs of obtaining and protecting intellectual property rights to the extent not offset by royalty income. This could subject the Department to enormous costs for underwriting patent infringement suits and trade secret litigation involving patents over which we have no management control. The government could be placed in the position of financing the contractors to litigate with each other. The Government has never borne such costs in pursuit of the licensing activities of private parties and it should not start now.

A Departmentwide task force on intellectual property is leading efforts to improve the Department's implementation of Executive Order 12591. This task force is also studying actions that will make intellectual property rights, including patent rights, software copyrights, and rights in technical data readily available to interested parties. Draft regulations are being completed which would provide much easier access to patent rights to the Department's laboratory contractors; a new policy is now in place providing blanket approval to the laboratories to obtain software copyrights; and legislation is being drafted to make rights in technical data readily available to cost-sharing contractors.

CONCLUSION

In announcing the Executive Order 12591 on Science and Technology, the President stated that, "a vigorous science and technology enterprise involving the private sector is essential to our economic and national security as we approach the 21st century...It is important not only to assure that we maintain American preeminence in generating new knowledge and know-how in advanced technologies, but also that we encourage the swiftest possible transfer of federally developed science and technology to the private sector. All of the provisions of this Executive Order are designed to keep the United States on the leading edge of international competition." I believe that the Department currently has the Executive Office support and the legislative authority that it needs to move toward both the President's goals and those of S.1480.

This concludes my statement, Mr. Chairman, and I thank you for the opportunity to appear before you today.

Senator FORD. Thank you very much, Madam Secretary.

I'm going to ask just a few questions, then let my two colleagues, who are cosponsors of the substitute and are somewhat more directly involved and more concerned, ask questions.

As I think everybody has agreed, these laboratories are managed to accomplish a stated mission, and part of the problem is that the mission doesn't include—at least from this Senator's understanding—the rapid commercialization of technology. Now, would you agree with that?

Miss FITZPATRICK. For the three defense programs laboratories, Mr. Chairman, that's basically true. The other laboratories perhaps do in other various descriptions, but the seven or eight other general multipurpose laboratories are supposed to be looking for rapid technology transfer. They do have very active industrial collaboration programs, and they maintain a great many facilities that are constructed and run specifically for the use of American industry.

Senator FORD. Sometimes we play on words around here. And you say "supposed to."

Miss FITZPATRICK. They do.

Senator FORD. Well, the point I want to make following that up is that my understanding, which is somewhat limited compared to my two colleagues here—the complaint that I hear is that DOE headquarters and DOE project offices are not interested in technology transfer. There is no enthusiasm or push as it relates to the transfer. And then on the other hand, we find—at least I do—that at the laboratories there is some real enthusiasm to see these ideas develop out in the commercial world. So, there is a fundamental mismatch in motivations as I feel it and as it relates to technology transfer.

Isn't there something that we could do to address this if we are to be serious about the technology transfer from our labs?

Miss FITZPATRICK. Mr. Chairman, I think that your point is well taken, and the Department has embarked on practical ways that we can, number one, assure the laboratories that we do want them engaged in technology transfer; and number two, make it possible for them to do it expeditiously. That was the principal purpose of the task forces which were operating beginning last winter and which recently have concluded their work.

There is no doubt that we can improve our procedures. We need to improve our contracting procedures. We need to clarify intellectual property rights as a result of almost 30 years of various pieces of legislation, executive orders, policy determinations and so on. We had a very confusing and still have, to some extent, a rather confusing picture on who can get patent rights and under what situations.

We need to improve the review process within the Department for proposals to do collaborative R&D work. There should be a very clear recognition of the difference between work done at the laboratories which is sponsored in part by government funds and in part by industry funds—obviously, we have to know when that is going on—and work which is done solely at the expense of industry where they come to a laboratory and say we will pay for it if you can do it. We, obviously, don't need to have the same review procedures for those two kinds of things. The reviews, to the extent that

they are necessary, should be decentralized out in the operations office, not at headquarters as much as possible. So, we have identified these and a number of other areas where we can improve our procedures, and we are working very hard to make those things happen.

Now, the purpose of the superconductivity pilot centers is not just to make those three particular laboratories available to industry to work on high-temperature superconductivity. What we are really thinking about is using those as the testing ground, the models, for deriving these kinds of new procedures that I've been talking about. Assuming they are successful, we would like to expand the special authorities that they will be given to all of the laboratories for all kinds of work.

Senator FORD. In listening to you in your opening statement that you couldn't agree with Senator Domenici more, and then to listen to you now in answering that question, which was very elaborate and very detailed and sounds extremely good, why couldn't we then do what Senator Domenici suggests? Since you're doing such a good job in this, why don't we codify these in this language so we can continue the good work without eliminating your review work and that sort of thing? Is there any prohibition in your mind, any opposition to that procedure, that you might have?

Miss FITZPATRICK. Yes, Mr. Chairman. We've had some detailed discussions with the Senator's staff, and they have indicated they would like to continue those, and we will. The topics for those discussions include such matters as whether there should be authority in the laboratories to use and commit government funds without any departmental review. The policy of the Federal Government has been that appropriated funds must be under the control of an executive agency which is responsible to the Congress for their use. And we are very concerned that that principle be upheld.

I think basically it's a question of language. It really came down to that. The phrase used in the bill is a "cooperative R&D agreement," and that is a term of art. That means that there are government funds involved. So, we said we cannot have a cooperative R&D agreement in which the Department does not have some kind of review authority, and the staff I think understood that. And we can discuss how to define the kind of agreement that the Senator has in mind that perhaps the laboratory could have some kind of autonomy on.

There are many different kinds of intellectual property and who should get the patent rights, for example, depends on the roles of various parties. If a company comes in and wants to do and is paying for research done in the laboratory, then the company should get the patent rights, not the laboratory. It would seem that by paying for the work that company has earned the right to enjoy the benefits of any patentable information that may arise.

And I think that what we would like to do is to continue our discussions to address some of these complexities which are real life situations that we're already trying to deal with so that we will, in fact, have a bill that will enable the laboratories to act expeditiously and enable the Department, first, to satisfy it's basic governmental responsibilities, but also to be an encourager and not a hindrance through this entire process.

Senator FORD. Let me ask you then, following up on that, on committing government funds. Isn't the big worry exceeding the cap on appropriations, or is there some other reason? If there is, what is it?

Miss FITZPATRICK. The basic principle is that a contractor to the Federal Government is responsible to the agency with which they are contracting for the use of funds, and the agency is then responsible to the Congress which appropriated the funds to account for those. And we think that that principle should be maintained. The bill as it is now written, as we understand it, would allow the laboratory, which is a contractor, a laboratory contractor, to commit funds without the review of the agency up to a limit for each project. But there could be many projects. And we could not explain to the Congress what is done with the money and we could not, in fact, coordinate that work with other work going on at other laboratories with other government funds.

Senator FORD. Are you familiar with what is being done with the spin-offs at NASA? There are many medical breakthroughs as it relates to our space program. Probably that's the largest spin-off for value for consumers.

Now, there are regional offices at universities that are there primarily for the purpose of seeing that those things that were developed under the space program are there to be given to the consuming public and they're available. And if you have a problem that might be solved, well, you can go to one of these regional offices and they'll work with you on whatever is available.

How did they come at that when we find here that we're running into all kinds of problems on how to get out the research done? These labs where the space program was very enthusiastic in even setting up offices to be sure that the taxpayer is able to receive a benefit back from the amounts of taxpayers' money that was put into the space program.

Miss FITZPATRICK. I think, Senator, part of that is a function of history. My understanding is that NASA was given that role virtually from its inception or very soon after, and so it was built into the way it was structured.

Senator FORD. Well, are we trying to build this into your structure now then?

Miss FITZPATRICK. Yes. The pilot centers are really envisioned to be that kind of a catalog directory to industry to say this is what is in this laboratory. This is what is available to you, facilitators of making the laboratories' resources to industry.

Senator FORD. In your prepared statement, you state that you strongly object to the bill because it will result in labs competing with private industry, as I understood it. How does this bill put the labs in competition with private labs?

Miss FITZPATRICK. The bill proposes that all work done in a national laboratory under its operating contract—and it's quite broad, all work—that any patentable invention that arose from that would be the property of the laboratory. We are concerned that the laboratories not be pushed so far in the direction of becoming entrepreneurs, that they use their very privileged position and the great resources that the Federal Government has devoted to them to compete directly with the private company which doesn't have

those same kinds of resources. And I have to say that we have at least the perception that that has occurred already, and we're very concerned that the laboratories not be seen as competitors. They should be resources because otherwise we're going to run into a situation where we'll have a lot of very angry people and a backlash against the laboratories. We are very concerned to maintain the laboratories as very positive forces.

Senator FORD. Now, they are not going to make widgets, as I understand it, but wouldn't labs license these rights to industry?

Miss FITZPATRICK. They should.

Senator DOMENICI. Mr. Chairman, would you permit me to just comment here?

Senator FORD. I'd be glad to.

Senator DOMENICI. I think we ought to understand and see if the Secretary agrees, but for the three nuclear laboratories under the former Senator Bayh-Dole legislation, the non-nuclear laboratories right now have become the owners of patents and copyrights. In that legislation as in this, we make it uniform, and then we say if the Department of Energy wants to exercise the right to be the owner of the patent or copyright, they may do it. The reason we're doing it this way is for uniformity and to make sure somebody is doing it.

And now the Secretary raised the issue of our million dollar collaborative contract and that patents may evolve in that which should be owned by the private company. Frankly, we weren't that specific. We're willing to talk about that. We thought perhaps that would be negotiated, and if you would like, we can work on how that should be negotiated.

This bill says $1 million collaborative agreements can be entered into by lab directors. If it's more than $1 million, you have a chance to negate it and say no. And it can't exceed $10 million. And in no event can it be more than 10 percent of the lab's business even 10 years from now. And their royalty rights stay there, but if they get to a be a certain percent, they come back to the Department of Energy to go into the general treasury.

Now, none of these provisions, Madam Secretary, are intended to take anything away from anyone. What they are intended to do is to make something happen that isn't happening.

And so, I hope that you understand—and I'm sure the Chairman does—that we have a disparity of rules. If you're at Argonne and something breaks, you're the owner of the patent. If you're at Sandia, you are not.

Miss FITZPATRICK. Right.

Senator DOMENICI. And we are saying why. Why shouldn't it be the same everywhere?

Now, one other comment on collaborative arrangements not being subject to a review. We will make it as clear as anyone wants that the collaborative agreement up to $1 million—anything over that you can cancel up here—that that has to be mutually beneficial so that the laboratory gains from it because they are putting their scientists to work on something meaningful to them that is also potentially meaningful to the private sector. And frankly, I do not believe there is anything wrong with that.

If you read the charter for these laboratories in the DOE original authorizing legislation, it contains language that one of the reasons for their creation was competitiveness—in its historic charter, the old one. We thought we had to look around for authority, but it happens to be there already, so we don't even have to change the charter, which we thought would run into all kinds of problems.

While we're on this one, let me suggest to the Chairman this is a very unique testimony because the DOE is testifying about this bill and other parts of the executive do not agree with their testimony. I mean, the science advisor has not signed off on this testimony. OMB has not signed off on this testimony.

Miss FITZPATRICK. Excuse me.

Senator DOMENICI. OMB has?

Miss FITZPATRICK. Yes. I was told they had.

Senator FORD. I didn't think you could do anything without OMB.

Miss FITZPATRICK. Exactly.

Senator DOMENICI. Well, there's the Department of Commerce that doesn't, and they have a lot to do with technology transfer.

Miss FITZPATRICK. I was told that the Department of Commerce had approved our testimony.

Senator DOMENICI. Well, we'll put some correspondence in here to the contrary, if you'd like, but that's what I understand.

Miss FITZPATRICK. Well, I would not pretend for a minute, Senator, that there is not a great deal of discussion throughout the government on a number of these issues. But we are trying to reach some kind of a consensus that is workable, and I can only reiterate that I fully agree with your goals, and I would like to continue to work with you to fine tune the bill so that we can avoid some of the pitfalls and get an expeditious process working.

Senator DOMENICI. Thank you very much, Mr. Chairman.

Senator FORD. I just have one more question.

This country boy has a hard time understanding all the scientific breakthroughs and how you arrive at them and what process you've gone through and how smart you have to be to be able to do all these things. Having been a small businessman, I don't quite understand how we can say that the labs—well, the labs are not going to be manufacturers of products.

Miss FITZPATRICK. No, they should not manufacture. That's true. Yes.

Senator FORD. So, then why put all these patents in the safe then or all this expertise and knowledge in a safe and not get it out to those people who are going to manufacture, who are going to give this to the consuming public or the private sector? It seems to me that once we do all this work, and you and I pay for it, and somehow or another we're not going to transfer that technology, that expertise, I thought once we had the breakthrough—this seems to me to be the problem that we're running into and we're getting behind in most everything. And so, therefore, we're not doing the research. We're not allowing some individual that has an idea that really you don't think will ever go anywhere, but he thinks it will—let him expand on that. So, we're saying, no, you've just got to do this. And it seems like to me that instead of putting it in the safe, we ought to give this technology to those people who can work

on it and get it out to the general public and let them benefit from their tax dollar.

Miss FITZPATRICK. I absolutely agree with you, Mr. Chairman. And what I'm saying is that the historical situation was that the government held title to patents which arose under work funded by the Federal Government. The trend over the last few years has been to transfer that title—for the government to waive its title and transfer it to the contractor in the national laboratory. I'm saying we should continue that trend and move it out of the national laboratory into the hands of the private company which has collaborated in that research. I want to keep it going.

Senator FORD. What about something where no private money has been involved and we do some research and all of a sudden it's ready and there's not anything that is objectionable as it relates to the defense of this country? What are we going to do with it?

Miss FITZPATRICK. In that case probably it could stay in the laboratory with the direction to the laboratory and incentives to the laboratory contractor that they should commercialize it. But this is one of the differences in situations that I referred to. The bill needs to recognize the diversity of situations. Work that was funded simply with government funds should not be treated the same as work which was funded in part by private funds. And that's the kind of difference that we would like to recognize.

Senator FORD. Well, I think it's more important to recognize government funds because that's everybody's money.

Miss FITZPATRICK. That's right.

Senator FORD. And you have the private enterprise in there trying to make a buck.

Miss FITZPATRICK. Well, that's what I'm saying. If they're in there working on it, they should get the patent rights and be free to commercialize it. We think that is the most expeditious way to get it out.

Senator FORD. Well, I don't quite understand all you're trying to do. I think I can make it a little bit simpler, but that's the way it is here. You've got to dot every I and cross every T, and then we have to go through OMB. [Laughter.]

Senator Domenici?

Senator DOMENICI. Well, frankly, Mr. Chairman, I'm very pleased to hear the Secretary talk about the private sector having more rights to patents and copyrights.

Senator FORD. Aren't we all?

Senator DOMENICI. As a matter of fact, had I put that in this bill, that a collaborating contractor would have proprietary rights to what they developed, I would have thought the Department, not necessarily this Secretary, but based on ancient history, they would have been down here saying the exact opposite. They would have been down here saying why should they get the patent for the government's work. That used to be the Department's opinion, not yours.

Miss FITZPATRICK. No.

Senator DOMENICI. But let me suggest to you that first we protect the Department because we have what we call march-in rights. So, if these labs get the patent or the copyright, you have the absolute right to march in and say it's yours. Our only goal there is to get it

done. And then we say it ought to get used. On collaborative agreements, we have left it open as to who owns them. Presumably the lab owns them.

But if you all would like to suggest that some language as to under what circumstances the private sector ought to own it, frankly, I think our approach is more flexible. If you're going to go negotiate an agreement, you negotiate about that property right. And if you would like to put in there that in those cases we ought to get some kind of review from you all, let's talk about that. But to me that's a much more flexible policy and a much better way to look at government and private money than to hold this bill up on the basis that there ought to be more private property rights when, as a matter of fact, if that has been the goal from the beginning, we're doing very poorly at it. And I think you would have to admit that.

Miss FITZPATRICK. Senator, I fully concur that the history has been that there have been a lot of people who have been very adverse to seeing any result of government-funded research end up in the hands and to the profit of a private party. And I think that is wrong because our system depends on getting the—the taxpayer gets the benefit only if it does get into the hands of a private person who can commercialize it.

We have made provisions in such areas as the steel initiative where we worked very hard and we met up with a lot of those types of people and had to overcome them to make sure that the private party in the steel initiative was able to get the rights.

Senator FORD. We hate to cut out on you, but we're afraid the hound dogs will get after both of us. And there's a vote over there, and we have three minutes.

Miss FITZPATRICK. Yes, sir.

[Recess.]

Senator DOMENICI [presiding]. We're going to reconvene. We're in the middle of a strange thing on the floor. I'm not sure how this is all going to finish, but I may have to go down there shortly.

Madam Secretary, let me preface this next statement and a few more specific questions with a positive statement about the Department because I may have left the wrong impression. So, might I do that?

Frankly, I'm going to say for the record that this Secretary of Energy in the last 18 to 24 months in my opinion, based upon 8 or 10 years of somewhat of a relationship with Secretaries of Energy, has come closer to moving the national laboratories in my opinion into a position of being more helpful to both the academic community of the United States in their basic science and research and, as recognized, the valuable role they can play in cutting-edge science and technology that has marketplace capabilities.

And that has not come easy for him. In spite of you all thinking you run the Department, there is a rather tremendous and abiding bureaucracy that comes back from the AEC days that is loaded with patent and royalty considerations. So, I think it has been tough. But I want to compliment him for it.

For instance, we now have an application for the first time in history where the National Science Foundation is using a national laboratory and two universities in one of their centers of excel-

lence. That is historic in my opinion, and I think it is the direct result of this Secretary saying we shouldn't be left out of that loop. Nonetheless, I am firmly of the opinion that we must move more forcibly in the direction of making them more useful to the private sector and, yet, do it in a sensible way.

Now, I would like to tell you that you indicated that you thought your testimony had been cleared by other agencies that normally clear testimony and concur with it. And I want to read this and then you can confirm it. If it's wrong, we'll put your statement in the record.

According to Holly F-I-T-T-E-R from OMB, "The testimony is only DOE's position and is not the administration's position on intellectual property. Various agencies agreed to disagree. OMB knows of the DOE testimony, but administration does not endorse it." I don't know what that means, but——

Miss FITZPATRICK. Neither do I.

Senator DOMENICI [continuing]. Maybe Holly Fitter is in a lot of trouble. [Laughter.]

Miss FITZPATRICK. Well, I can only say I was aware when I left town on Monday that there was still a good deal of controversy. I was told when I came back this morning that Commerce had withdrawn their objections. Perhaps I misunderstood what that meant and that OMB had cleared the testimony.

Now, it may be a fine point, but I think that the main point, which is that there is, indeed, disagreement and there are people around who still think that either that we should not be letting patent rights go or that we should handle them in various ways—I think we have to recognize that those opinions exist.

Senator DOMENICI. Let me ask you. Again, I want to do this in no way to be confrontational, but you told us that we ought to keep the flexibility of trying to draw regulations and changeable rules with reference to things like copyright policy because it's an evolving kind of thing.

I would like to share with you, if you're not aware of this, your latest draft of a copyright policy. This refers to your latest attempt to handle software copyright, and I have a letter from Control Data, John E. Iffland, General Manager, who has reviewed it.

My summary of what it says is it ain't going to work. He says, "The concept interjects such risk that it is our opinion that any future licensing of technology and subsequent investment to make productive would not prudent business sense." And I'll give you the letter for you to review.

Miss FITZPATRICK. I'd be very happy to have that, and I'd like to discuss with him what we might do to improve it because we fought very hard to get this far. And I'd be perfectly willing to say perhaps it wasn't far enough and we can improve it more.

Senator DOMENICI. Now, regarding strategic defense initiative research work done at the national laboratories, in your opinion where the work is done—that is, a weapons laboratory or an energy laboratory—how does that affect the ownership of intellectual property of federally funded research? I'll just ask my question. Wouldn't it better policy to have uniform procedures based on what the invention is and make more sense than where the invention took place?

Miss FITZPATRICK. Yes. And I think that that is, as I said, one of the goals of the present activities that we're undergoing, and that is to achieve as much as possible uniformity among all the laboratories whether they're defense programs or ER, and not to have unnecessary distinctions.

That's why the superconductivity pilot centers are three, one a defense laboratory, and two energy laboratories, and the two energy laboratories, one a nonprofit contractor and another for-profit contractor. We're trying to get the diversity of the types of laboratories and contractors that we have and try to find a uniform way for them to work.

Senator DOMENICI. I have a number of other questions. I think in the interest of time, with the Chairman's permission, I'm going to submit them for the record for you to answer if you might at your earliest convenience.

Thank you very much, Mr. Chairman.

Senator FORD [presiding]. Senator Bingaman?

Senator BINGAMAN. They're starting another vote. Do you want me to go ahead with my questions?

Senator FORD. Sure, go ahead. Yes.

Senator BINGAMAN. As I understand it, ARCH Development Corporation there at Argonne——

Miss FITZPATRICK. Yes.

Senator BINGAMAN [continuing]. Has an arrangement or a clause in their contract which gives them local control over patent decisions. Is that inaccurate?

Miss FITZPATRICK. My understanding is that ARCH is a creature of the University of Chicago, which is the contractor at Argonne.

Senator BINGAMAN. Right.

Miss FITZPATRICK. The purpose of ARCH is to find licensees for the patent rights that have been waived to the University of Chicago as a laboratory contractor. That is, they got the rights from the government. They now have them. It is up to them to find people to use them, and they created ARCH as their vehicle for doing that.

Senator BINGAMAN. So, the rights were waived to the University of Chicago.

Miss FITZPATRICK. Yes.

Senator BINGAMAN. And that's because they're one of the non-defense labs.

Miss FITZPATRICK. Right.

Senator BINGAMAN. And that's your policy now.

Miss FITZPATRICK. Yes. They are a nonprofit, non-defense laboratory, nonprofit contractor to a non-defense laboratory. Therefore, they are already covered by contract provisions prescribed by law and regulation. They are told ahead of time you're going to get the rights to what comes out of this research.

Senator BINGAMAN. Now, the legislation that we've got in here, 1480, would basically try to go ahead and do the same thing with regard to patent rights for the three defense labs.

Miss FITZPATRICK. Yes. Well, actually it doesn't discriminate about defense laboratories, it simply names——

Senator BINGAMAN. It just says all labs.

Miss FITZPATRICK [continuing]. All the national laboratories, and then it says all of them would get patent rights for any work arising under their laboratory operating contract.

Senator BINGAMAN. With the Department of Energy retaining certain of these rights to override that.

Miss FITZPATRICK. Yes, on the basis of national security considerations for the most part. It is not a blanket override the Department can exercise. It is specifically for certain reasons.

Senator BINGAMAN. For national security reasons.

Miss FITZPATRICK. Yes, exceptional circumstances and national security, yes. But exceptional circumstances has a very special meaning. It's not just any set of unusual circumstances.

Senator BINGAMAN. Do you believe that there are circumstances in which the Department of Energy should be able to override the waiver or the granting of those patent rights other than national security and those exceptional reasons?

Miss FITZPATRICK. I'm saying that the basic thrust of our policy—and I would hope of legislation—would be that the best vehicle to commercialize work arising out of research in the national laboratory may often be a private party which helped to pay for that work. So, I'm saying don't stop it at the laboratory. Provide also where proper and reasonable to move it out of the laboratory, in fact, to a private party.

Senator BINGAMAN. Yes, but I'm trying to focus on the circumstances where the Department of Energy would not want either the private party or the lab to have the patent. Are there circumstances other than national security and these—whatever that other phrase was you used——

Miss FITZPATRICK. Exceptional circumstances.

Senator BINGAMAN [continuing]. Exceptional circumstance as defined in this bill where you think the Department of Energy should have the right to keep either the lab or the private firm from getting the patent?

Miss FITZPATRICK. No, I can't think of any, and I'm not sure that there would be any. All of this, of course, is subject to the usual right of the Department and its other contractors to use the patent for government purposes. So, since that right exists anyway, that is taken care of.

Senator BINGAMAN. That's not affected by this legislation.

Miss FITZPATRICK. That's right. So, provided that that is there, I can't think of other reasons why we might want to withhold patent rights.

Senator BINGAMAN. So, you're not objecting to the legislation on the ground that it gives rights that should be retained by the Department of Energy.

Miss FITZPATRICK. No.

Senator BINGAMAN. You're objecting to it on the ground that it grants rights to the laboratories which in some cases should go directly to the private firms.

Miss FITZPATRICK. That's right.

Senator BINGAMAN. And the labs should not have to sign off on giving them to the private firms.

Miss FITZPATRICK. That's right. I'm saying, in effect, that I don't think it really goes far enough to advancing the commercialization——

Senator BINGAMAN. So, you're saying that if this legislation where a little better designed to open this process up, you folks could support it.

Miss FITZPATRICK. I think so. You see, we hear from industry also, and they are very concerned when they go to work with the laboratory or when you tell them would you like to work with the lab. They say it's so hard for us to get the patent rights.

Senator BINGAMAN. And that's the labs' fault as you see it. It's not the Department of Energy's.

Miss FITZPATRICK. No. I don't think it's that you want to find fault. The patent right situation is the result of many years of legislation, executive order, departmental policy, a whole conglomeration. And that is why we have so different rules for different situations. We're trying to get some uniformity and we're trying to open it up so that industry, when it thinks about going to the laboratory, knows that it is going to get a reasonable deal on the intellectual property rights. And that's why, if we're going to start codifying these policies, I would like to see that made very clear that it doesn't stop with the laboratory, that the bias, if you will, is to move it out into industry.

Senator BINGAMAN. Now, you say here on page 11 of your testimony, "Legislation is being drafted to make rights and technical data readily available to cost sharing contractors." Is that something which could be amended into this legislation to solve that problem?

Miss FITZPATRICK. Quite possibly. But if you think there's controversy over patent rights, you should hear the controversy over technical data. It's an even thornier issue. I think the Senator wants to move something this year.

Senator BINGAMAN. I see. So, you don't expect to have a consensus within the administration on legislation to deal with technical data.

Miss FITZPATRICK. Or possibly in the Congress either. It is a much more difficult issue to define. Technical data is a much more amorphous kind of an animal than patents. Everybody knows what a patent is. It's quite clear when you have a patent and when you don't. Defining what technical data is and what would be controlled or what would be exempt from certain controls is extremely difficult.

Senator FORD. Senator, I don't want to interrupt your questioning, but we do have five lights. And if you have any other questions for Secretary Fitzpatrick, maybe we can submit them to her in writing.

Senator BINGAMAN. I'll be glad to do that, Mr. Chairman. Thank you.

Senator FORD. Now, Mr. Alic and Mr. Smith, we've got two options. We can be doing this the rest of the afternoon and not know. You can submit your testimony for the record, and we'll see that it is in there. We can have the testimony taken by staff council while we're away. There are a lot of options. So, Mr. Alic and Mr. Smith, the option is yours. And so, however you want to do it, we'll do it.

We have to go vote. And if you would like to just submit your testimony for the record, we can do that. Otherwise, we're going to be bouncing back and forth I think like this all afternoon. We're on the DOD authorization bill, and that gets to be a little bit thorny.

[Whereupon, at 3:28 p.m., the hearing was adjourned.]

[The prepared statements of Mr. Alic and Mr. Smith follow:]

STATEMENT OF

JOHN A. ALIC

SENIOR ASSOCIATE, OFFICE OF TECHNOLOGY ASSESSMENT

BEFORE THE

SUBCOMMITTEE ON ENERGY RESEARCH AND DEVELOPMENT

COMMITTEE ON ENERGY AND NATURAL RESOURCES

UNITED STATES SENATE

MAY 11, 1988

Mr. Chairman and Senators, I am pleased to be here today to testify for OTA on the commercialization of new technologies in the context of this hearing on the proposed Department of Energy National Laboratory Cooperative Research Initiatives Act, S. 1480 and the proposed amendment to the bill (Amendment 1627). With me is W. Wendell Fletcher, deputy project director for OTA's assessment on commercialization of high-temperature superconductivity (HTS).

We expect OTA's Special Report on commercialization of HTS -- the first of two pieces of work on this exciting new field -- to be released next month. The second OTA report, covering in more depth the science, technology, and potential applications, will be out in about a year. Given the pace over the past 15 months, much will have changed by then.

Energy and Natural Resources was one of the committees requesting these assessments. Thus I can comment on HTS specifically, as well as on commercialization in general. After touching on the Federal R&D budget for HTS, I will turn to the role of the Energy Department and its laboratories in superconductivity -- the concerns of Title I of S. 1480 and Amendment 1627. I might also mention that OTA's report Mapping Our Genes, released last month, addresses some of the technology transfer issues covered in the proposed legislation.

COMMERCIALIZATION

The Government Role

Private industry commercializes new technologies (as well as products and manufacturing processes based on existing knowledge). For its part, the Government does two things. First, Federal agencies pay for half the Nation's R&D -- in 1988, $65 billion of the $132 billion total. Private companies perform some of this R&D under contract, in addition to being customers for

results. Second, Government policies influence the environment within which firms commercialize and compete. A host of economic and regulatory policies affect innovation and technology development within the private sector.

The money Federal agencies spend on R&D, the ways they spend it, their efforts to transfer technologies to industry -- actions taken every day by more than a dozen agencies -- affect the Nation's (and the world's) storehouse of technical knowledge. When companies search for competitive advantages through proprietary technology, they draw continually on this publicly-funded, publicly-available technology base.

Commercialization in Industry

American firms have been falling behind in the race to commercialize. A decade ago the semiconductor industry still seemed a bastion of U.S. strength. The Japanese were nibbling at the margins, no more. Today, the Federal Government finds itself putting money into Sematech, trying to help American firms regain a technological lead lost seemingly overnight. The Japanese have made equally rapid progress with electronic and structural ceramics.

Many parallels have already emerged between HTS and both microelectronics and ceramics. All the new superconductors discovered so far have been ceramics. Although they have much different properties than the materials in current use for electronic substrates, or pre-chambers for diesel

engines, the Japanese firms that have pioneered in high-technology ceramics will be well placed when it comes to fabricating superconducting wires, cables, tapes, and conductors.

Manufacturing and design will be tightly interwoven, as in microelectronics, with technology ahead of the underlying science. Few U.S. semiconductor firms can afford the time and money to mount a scientific attack on, for example, the process variables that affect manufacturing yields, costs, and quality. They must solve problems today so they can compete in the marketplace tommorow.

HTS is not yet at this stage. There is no marketplace. The race is still a scientific race. But if HTS lives up to expectations, we could see a replay of some of the history of these other industries.

Problems and Solutions

U.S. problems in commercialization are rooted in technology and its use, not in science. Short-sighted management decisions, caused in part by pressures generated in U.S. financial markets, deserve part of the blame. American corporations have backed away from longer-term R&D, supporting less of the generic research needed to build a base for commercializing new technologies, and avoiding the high-risk projects that could lead to big payoffs, but payoffs that are well in the future.

The technical community also deserves part of the blame. The Japanese today are out-engineering their American rivals in many industries. Engineering schools and the engineering profession have lost sight of the marketplace, and failed to give manufacturing technologies their proper place.

On the Government side, defense-related R&D leads to major new commercial products or processes less frequently than in earlier years. The needs of American universities for new laboratory equipment have not been attended to. Federal funds for applied research that would fill the gap between basic science and the short-term projects conducted by industry have been cut back.

For such reasons and more, the U.S. technology base may no longer be adequate to support an internationally competitive set of industries. Where neither Government nor industry see an immediate need for R&D, gaps open. This may already be happening in HTS. Budget uncertainties in the R&D agencies, which lasted well into the current fiscal year, put many Federally-funded projects on hold, slowing U.S. progress at a time when American companies have not been matching the commitments of their Japanese rivals.

Given the constraints on the Federal budget, we cannot expect to solve these problems by spending more money. Nor should we have to: already, the U.S. Government spends more on R&D than industry and government together in Japan. Instead, we must manage the Federal R&D budget more effectively.

Certainly the United States can make better use of the national laboratory system -- one of the goals of S. 1480. In addition to stronger ties to industry, this may mean new missions for some of the laboratories. And perhaps the Federal laboratory system, now including more than 700 facilites, should shrink; perhaps public funds could be spent more effectively elsewhere in the Nation's R&D system.

GOVERNMENT FUNDING FOR HTS R&D

In fact, it is hard to criticize the magnitude of U.S. Government spending on HTS R&D. Federal agencies have about $92 million for HTS in fiscal 1988, nearly twice the 1987 total. Although little of this represents new budget authority, the U.S. Government will spend more on HTS alone than Japan's Government will spend on HTS plus low-temperature superconductivity (LTS).

OTA's survey of U.S. industry indicates that private companies will spend some $68 million this year on HTS -- less than Federal agencies. The new technology could remain in the laboratory for 5 to 10 years or more. For much of this period, the Federal Government will remain a primary source of R&D funds. Effective support for commercialization will require stability in Federal funding, attention to priorities, and good management of agency R&D budgets.

With this in view, OTA's Special Report on commercialization will discuss policy options such as a benchmark, multiyear funding plan for HTS R&D that could be adjusted periodically (but not by any means a rigid blueprint). To emphasize the need for continuity, Congress might consider multiyear authorizations and two-year budgeting for HTS on a trial basis. Such mechanisms can help Congress and the Administration establish and maintain priorities.

Why do I emphasize priorities? Of the 1988 total for HTS R&D, 30 percent ($27 million) will go to DOE -- nearly twice as much as the National Science Foundation will have to support HTS in the Nation's universities. Given that HTS is still a new field for research, and given the great strength of the American university system in basic research, the allocation of Federal R&D funds seems out of balance. In any event, with much of the DOE money to be spent within the national laboratories, technology transfer and interactions with industry will need continuing attention.

DOE AND THE NATIONAL LABORATORIES

Several of the DOE laboratories have strong foundations in superconductivity stemming from years of work on LTS magnets for high-energy physics research, along with such projects as Brookhaven's 10-year effort on electric power transmission. A number of the laboratories have excellent

equipment for synthesizing and characterizing the new HTS materials. They have physicists, chemists, and engineers with the skills and experience to contribute to the science and technology base for HTS.

DOE's laboratories do not, however, have much of a track record in helping industry commercialize new technologies. The task, as S. 1480 recognizes, is to utilize their resources more effectively. If cooperative arrangements and rapid technology transfers to industry are to flourish, the laboratories will have to change in style and culture.

Of course, the laboratories are changing already. Indeed, given the shifts already underway in the relationships between the laboratories and industry, it may be that S. 1480 could go considerably further in some of its provisions.

Cooperative R&D

Title I of Amendment 1627 would direct the Secretary of Energy to establish cooperative research centers for HTS at DOE laboratories. The proposed amendment would also grant the laboratories new freedom to negotiate cooperative arrangements with industry, and to enter into technology licensing agreements with private firms.

Federal participation in cooperative R&D could help solve a number of persistent problems in commercialization. Companies know, or think they know, what will sell and what can be manufactured. The laboratories would

contribute technical capabilities and research dollars. Their experience is in R&D, not in production. Cooperative ventures should help bring manufacturing issues in early, addressing a major U.S. weakness.

Private sector ventures such as Microelectronics & Computer Technology Corp. (which has itself begun a project on HTS) operate with time horizons little different from those of member companies. MCC is currently restructuring its largest program, in advanced computer architectures, to promise more immediate paybacks. Federal dollars can extend private-sector time horizons, helping counter the short-term thinking that has afflicted U.S. industrial research.

Furthermore, as laboratory scientists and engineers work alongside industry employees, the two parties will come to understand one another better. The culture of the laboratories will begin to change, and industry should come to view the laboratories in a more positive light.

What Will It Take for Successful Laboratory-Industry Cooperation?

Industry will have to take much of the initiative if the DOE laboratories are to aid in commercialization. Firms must be willing to search out areas of expertise, and seek to take advantage of them. At present, however, many companies perceive the DOE bureaucracy as set up to frustrate joint R&D. For such reasons, OTA believes the provision in Amendment 1627 permiting the laboratories to negotiate cooperative agreements of up to $1 million without review by the Department is a reasonable one.

Industry must contribute a substantial share of project funds. When Federal dollars cover too high a fraction, companies no longer feel they have a stake in outcomes; projects can stray from the needs of commercial technology development. Forty percent cost sharing by industry is probably a reasonable minimum. Language to this effect in S. 1480 might be desirable.

Yet industry cannot have too much control over research goals, else time horizons will shorten: unless cooperative projects have riskier and/or more fundamental R&D objectives than companies would pursue on their own, there is little justification for Government participation. This suggests projects that last 3 to 5 years or more. (Some government-industry projects in Japan have had 10-year time frames.)

Cooperative R&D could take many different forms. Firms might work with the laboratories singly or in groups. Potential rivals might choose to pursue pre-competitive projects jointly; firms in quite different businesses with similar R&D objectives might cooperate, or those with supplier-customer relationships. At this point, we know relatively little about the ingredients of successful cooperative projects. Certainly, both industry and the laboratories will have to change. Given this, it seems appropriate to encourage a variety of approaches on a trial basis.

OTA suggests that, rather than letting the 13 laboratories covered by Amendment 1627 go in their own directions, the Committee consider an experimental program among a smaller group of laboratories -- say 5. Each might pursue cooperative projects in HTS that vary in relationships among the firms involved and the types of R&D objectives (generic research; long-term, high-risk efforts). Such a program need not affect ongoing HTS R&D at other laboratories.

Regardless of the final decisions on cooperative R&D, mechanisms for evaluating differing approaches, and disseminating the results -- and not just the success stories -- seem highly desirable. New approaches might emerge with relevance broader than superconductivity.

Personnel Exchanges

Title I of Amendment 1627 makes explicit provision for personnel exchanges between industry (and universities) and the national laboratories. This could be a big help in altering the culture of the laboratories, so long as the exchanges remained a two-way street.

The laboratory system attracts many highly competent technical people with more interest in research than in the practical problems of industry. They need exposure to these problems to understand how the marketplace works, and to give the greatest help in commercialization. Bringing people from industry into the laboratories may have more short-run impacts on HTS, but

laboratory employees will have to take frequent temporary assignments in industry if, over time, the laboratories are to become better integrated into the Nation's technical infrastructure.

OTA sees no reason for linking personnel exchanges exclusively to cooperative R&D agreements. S. 1480 might be strengthened by provisions that would establish fellowship programs sending laboratory engineers and scientists to private industry for periods of 6 months to 2 years. One hundred fellowships per year would begin reaching enough laboratory employees to make a difference; they could be required to work on problems of mutual interest, with the laboratory paying half their salaries and maintaining their pension eligibility benefits.

CONCLUSION

To maintain its competitiveness, the United States must generate today the technical knowledge that industry will depend on tomorrow. We are not doing so. OTA's analysis points to such needs as: better mechanisms for setting priorities in the R&D agencies; greater stability and continuity in funding; and a strategic view of the ways in which Federally-funded R&D can spur economic growth and competitiveness. HTS illustrates some of the problems. HTS could also be an opportunity to find solutions.

Technology transfer from the national laboratories to industry has significance going far beyond superconductivity. So does cooperation in R&D. While these are only two pieces in a complex puzzle, more effective interactions among the major players in the U.S. R&D system -- universities, industry, the national laboratories -- could help speed the generation of technical knowledge, and, perhaps more importantly, its use.

With new knowledge eventually becoming available everywhere and to everyone, those who use it fastest and most effectively will come out ahead in international competition. U.S. industry has been falling down in the utilization of technology. The national laboratories could help. This will mean a significant redirection of laboratory missions. Such changes take time, but few HTS-based technologies will reach the marketplace for 5 or 10 years. The United States has time to get its house in order.

Pre-filed Written Statement of
Ora E. Smith
Director, External Technology Development
Rockwell International Corporation

To the Senate Subcommittee on Energy Research and Development
Concerning the National Laboratory Cooperative Initiatives Act--
S.1480

May 11, 1988

Introduction

Rockwell International is a high technology diversified manufacturing company serving industry and government. Our businesses include electronics, aerospace, automotive components and systems, industrial controls, newspaper production equipment, valves and meters, and industrial sewing equipment. Our total annual sales for 1987 were over $12 billion. One of my responsibilities at Rockwell is to help our various businesses gain access to and effectively utilize technical developments originating from outside the Corporation. We have enjoyed a long and fruitful relationship with many of the National Laboratories, including being the current operating contractor of the DOE's Rocky Flats and Energy Technology Engineering Center facilities, and the prior operating contractor of the Hanford facility, and I welcome the opportunity to comment on Senate Bill 1480, especially Title IV, relating to technology management at the Department of Energy

National Laboratories.

Rockwell has historically had a good relationship with the DOE labs, as well as with federal laboratories under the management of the Department of Defense and NASA. Not surprisingly, our strongest relationships with the DOE labs have been on behalf of the parts of our company concerned with the mission areas of the labs, that is, nuclear energy and strategic defense. Recently we have seen a broadening of interactions between Rockwell and the DOE labs to include our aerospace vehicle businesses, and there is even one connection being tentatively explored between our meters and valves business and the Argonne laboratory. In addition we have had for years many useful scientific collaborations between researchers at our central corporate R&D laboratory and several of the National Laboratories. In a nutshell, I believe we have very strong relationships with the DOE labs in areas in which the labs' primary missions and our business areas overlap, and that we are making progress in making further connections. The big challenge is to connect those parts of our company not directly concerned with the labs' primary mission areas, particularly the so-called "commercial" parts of Rockwell, that is, those businesses which do not sell primarily to the U.S. government.

I have personally noted a substantial change over the past several years in the attitude of both industry and the DOE labs

toward establishing mutually beneficial relationships. To the extent that we have not reached an optimum use of the National Laboratories by industry at least half the blame must fall on industry for not having pushed harder to develop innovative and effective ways to use the laboratories. I believe that most of us in industry, being faced with stiff competitive challenges from all over the world, are doing our best to look out for our long term technical needs without sacrificing the current economic health of our businesses. This is a difficult line to walk, and I think federal lab interactions may have suffered because, unlike company internal R&D investments, they are perceived as having no "track record" of substantial economic return. Without the precedent of success companies are reluctant to invest increasingly scarce resources in interactions with the National Labs. However, there are some pioneers, and as more success stories emerge more companies will see value in working with the labs.

Title IV

I have specific comments relating to Title IV of S.1480 that I would like to make. The first comment concerns the protection of intellectual property. I commend the Committee on including provisions to strengthen the acquisition and protection of intellectual property rights, and providing mechanisms to assure commercial exploitation of them by all parties, including large com-

panies. I would, however, like to suggest that the Department of Energy should also be asked to pursue aggressively intellectual property protection in other countries. While foreign patents may often be more expensive than U.S. patents to file and maintain, so much of the future growth of U.S. business is tied to exports that it would behoove us to make sure that we are maximizing the economic value of our inventions by protecting them in other countries where they might be manufactured and sold. For example, a patent issued only in the U.S. would not prohibit the manufacture, use or sale of goods covered by that patent elsewhere in the world, and in many cases the bulk of the economic value to be derived from such a patented invention might come from foreign countries. To be without foreign patent protection in such a case could have a serious adverse effect on the U.S. patentee or a manufacturing licensee. Also, in the absence of process patents in the foreign country of manufacture it may be difficult as a practical matter to pursue successfully an infringement claim for goods infringing the U.S. process patent and imported into the U.S. Clearly increased foreign protection is desirable. Foreign inventors are receiving about one-half of all the patents granted in the U.S. We should imitate such foreign patent filing practices in the U.S. and pursue intellectual property protection more vigorously in other industrialized nations.

One feature of Title IV which may be controversial is the provision which transfers to the laboratory directors much authority for constructing cooperative relationships with industry. I believe this to be a positive change, provided it does not lead to the laboratories' compromising their primary missions which are of critical importance to the national interests of the U.S. The proposed autonomy at the laboratories is very similar to the way Rockwell and other companies delegate management authority. The Congress, representing the people of the United States is analogous to the shareholders of a company, the Secretary of Energy is like the corporate Chief Executive Officer, responsible for overall strategy, and the laboratory directors can be thought of as presidents of divisions, responsible for the actual operational success of their organizations. I think the experience of American industry has been that the best results are achieved when the heads of the business units are allowed to operate with great autonomy, entrepreneurially, in the absence of "micromanagement" from corporate headquarters. This is not to say that "headquarters" should abdicate all control. In our company the heads of business units are measured frequently and rigorously on their long term and short term performance, and the results show up in their compensation and in their continued employment. The role of the chief executive is to create an effective strategy for the organization, and to make sure all the business heads understand it and are committed to it. He also puts together with each business head the objectives by which the

performance of that business will be measured. My suggestion is that this kind of "big organization entrepreneurialism" should be tried by DOE, and I am happy to see it incorporated in S.1480. I think industry will easily be able to relate to this management style.

One of the keys to increasing the commercial output of the National Laboratories is to increase the personnel flow between industry and the laboratories. I am pleased to see that Titles I-III of the Bill specifically address the need for personnel exchanges. I would further suggest that the Secretary of Energy might consider asking his laboratory directors, if they have not already done so, to empanel advisory groups from industry to help them develop ways to optimize industrial interaction.

I very much appreciate the opportunity to appear before this Committee and I hope my comments have been helpful.

APPENDIX

RESPONSES TO ADDITIONAL COMMITTEE QUESTIONS

J. BENNETT JOHNSTON, LOUISIANA, CHAIRMAN
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GARY G. ELLSWORTH, CHIEF COUNSEL FOR THE MINORITY

United States Senate
COMMITTEE ON
ENERGY AND NATURAL RESOURCES
WASHINGTON, DC 20510-6150

May 16, 1988

The Honorable Donna Fitzpatrick
Assistant Secretary
Conservation and Renewable Energy Programs
U. S. Department of Energy
Washington, D.C. 20585

Dear Ms. Fitzpatrick:

I want to thank you for presenting testimony before the Subcommittee on Energy Research and Development on S. 1480, the "National Laboratory Cooperative Research Initiatives Act" and Senator Domenici's proposed amendment No. 1627. I apologize for the disruptive manner in which the hearing had to be held, due to repeated votes on the Senate Floor.

I have enclosed additional questions from Senator Domenici to be provided for the hearing record. As you know, Senator Domenici is seeking to mark-up S. 1480 as soon as possible. Therefore, I am requesting that the answers to these questions be provided to the Committee no later than May 31, 1988.

If you have any questions concerning this request please contact Ben Cooper at 224-7569.

Sincerely,

Wendell H. Ford
Chairman, Subcommittee on Energy
Research and Development

WHF/tc

**FOLLOW-UP QUESTIONS FROM SENATOR PETE V. DOMENICI
FOR ASSISTANT SECRETARY DONNA FITZPATRICK
DEPARTMENT OF ENERGY**

1. Is it true that a recent internal task force review shows that over one half of potential private sponsors of research and development at DOE laboratories rejected the DOE "work for other" terms and conditions?

2a: You mention the "significant progress" that DOE is taking with its nonprofit contractors. The 1980 law giving universities title to patentable inventions had to be amended by Congress in 1984 to force DOE to waive rights to its university-operated labs. Last month the University of California filed a law suit against you because of you attempts to take away inventions under "exceptional circumstances." In other words, after 8 years DOE still find itself unable to implement a law that every other Government agency has been using and which GAO found is the basis for our highly successful industry-university cooperation. Why does DOE have so many problems following a policy which every other agency easily adapted.

2b: Is it true that you dropped your attempt to take technologies away from the University of California under "exceptional circumstances" after they sued you, but DOE is attempting to keep identical provisions in all of your other laboratory contracts? Isn't it also true that DOE is attempting to use a Department of Defense list of sensitive technologies which we are not exporting to communist countries as a pretext to take rights away from DOE labs when DOD has never used their list in this manner?

3a. The President in Executive Order 12591 directs all agencies to permit contractors to own computer software in exchange for a royalty-free license to the Government. The new DOE policy goes far beyond this. You are attempting to force your contractors to pay back to DOE 5% of their royalties to subsidize your highly centralized computer software program in Washington. Why should contractors, who are much more effective at tech transfer than DOE headquarters, be forced to subsidize this Program?

3b. Why does DOE want to make highly proprietary computer software codes available at DOE's software centers to anyone who wants it including the Japanese, the French, the Russians and the Libyans? Is there any Administration policy basis for this?

4. You mention that my bill gives "indiscriminate" intellectual property rights to the contractor. Please explain the difference between the allocation of rights in Title IV and the President's Executive Order?

5. Industrial participants have not been put off by negotiating patent licensing agreements with universities according to the GAO which found a 74% increase in industry funding of universities in the last eight years. What is your basis for attempting to force university-operated laboratories to assign the entire ownership of an invention to an industry cost sharing the research and development rather that a license or assigning ownership of the patent to industry is appropriate without Washington's interference?

6. You state (p.5) that you are studying technology transfer mechanisms in the area of defense programs and that such efforts will "perhaps" contribute to U.S. competitiveness. Evidently you have some doubts. What are they?

7. You argue (p.7) that giving lab directors the authority to enter into Government-funded cooperative R&D arrangements could abbogated both the appropriating authority of the Congress and the management responsibility of the Department. S.1480, as redrafted, contains various safeguards and controls. In addition, Congress would be expected to subject this authority to the same oversight process as any other program that is responsible for the expenditure of federal dollars. Why aren't these adequate?

8. Your discussion (p.10) of "exceptional circumstances" appears to advocate denying a lab the right to elect to take ownership if an invention is in a field of technology that is subject to export controls. This could cover thousands of possible inventions.

(a) Isn't the practical effect to deny the lab the right of election and to require case-by-case review in virtually all cases?

(b) Aren't the patent secrecy provisions of title 35 sufficient to protect the nation's legitimate security interests?

(c) Is it true that the University of California recently sued DOE has agreed to modify its position at least with respect to California?

(d) Is DOE continuing to apply export control regulations as a basis for determining ownership rights for all of its other contracts?

9. I understand that DOE has argued that it cannot completely abide by the President's memorandum of Feb. 1983 directing agencies to apply the Bayh-Dole Act to contractors other than small businesses and nonprofit institutions. Sec. 407 of the redraft elimates the legal impediments allegedly raised by the Atomic Energy Act and the Federal Nonnuclear Energy Research and Development Act. Do you support it, now that it will enable you to follow the President's policies without reservation?

10. You state (p.9) that vesting ownership rights in the laboratories "indiscrimately" could undermine the objectives of technology transfer. Obviously the aim is to give the lab the right to an invention made by a lab employee under a cooperative R&D arrangement so that the lab can use this as a bargaining chip to attract potential partners and negotiate the best possible deal. This is the same principle that underlies the Federal Technology Transfer Act itself. Please explain your objection more fully?

11. You have expressed concern throughout your testimony that the various provisions could subject the Government to liability, particularly with respect to trade secret and patent litigation. How does the principle of contractor ownership lead to this problem here when it hasn't anywhere else?

12. With regard to new DOE software regulations, could you explain why it is necessary in all cases, to make source code, available to the public via the NESC, when this could be an inhibition to licensing such software. This requirement certainly increases the business risk to the licensee's investment to develop this product. Also why was it necessary to take 5% of the gross copyright royalties, which also creates a disincentive for private investment.

13. S.1480 specifically gives DOE "March-in rights", if the labs do not license out technology for which they have acquired title, to private industry for commercialization purposes. Doesn't this provision ensure that the labs are not going to "compete" with private industry?

14. This bill grants the laboratory directors authority to enter into cooperative research and development contracts or colloraborative research arrangements with industry. This is done in an effort to make the laboratories "user-friendly" and tomake sure that greater use of the technology developed at the laboratories is further developed my U.S. industry. It does not in any way limit the DOE's ability to oversee and audit. It does not in any way change the important oversight role of Congress.

Your testimony takes a different view. Would you tell me which sections of the bill you feel eliminates the Congressional oversight and the broad authority given to the Sectetary of Energy, the extensive auditing nad oversight authority granted the Comptroller General and the Inspector General in the statutes outlined below. There is nothing in the bill that in anyway diminishes this important oversight function.

Furthermore, pursuant to the broad authority given to the Secretary, the contracts between DOE and the laboratory operators are very specific. I would like to ask that the text of the pertinent parts of the DOE-University of California contract appear in the record.

15. One of the problems that you raise in your testimony is that this bill would allow laboratory directors to enter into small cooperative research and development or collaborative agreements without DOE review and approval. Three Energy Research Advisory Reports and a report of the President's Science Advisor all have made recommendations that support this provision of the bill. How do you reconcile DOE's position with six year's of consistent recommendations from Energy experts?

BACKGROUND

The role of Doe laboratories and their relationship to industry has been considered in a number of studies and the provisions of S.1480 closely follow those recommendations.

In particular, the ERAB reports, The DOE Multiprogram Laboratories (ERAB, 1982) and Guidelens for DOE Long Term Civilian Research and Development (ERAB, 1985) deal explicitly with technology transfer in their recommendations.

Key technology recommendations made in 1982 and 1985 ERAB reports include: allow laboratories to do more reimbursable work with industry; to enter into cooperative agreements up to a specified level without prior DOE approval; develop a policy of cost-sharing with industry that is consistent both internally and with other federal goverment policies.

In 1983, the Office of Science and Technology Policy (OSTP) published Federal Laboratories Review (OSTP, 1983) The recommendations made for technology transfer include; allow greater flexibility for laboratory directors in contracting;

permitting more collaborative projects and allowing industry to fund more work at the laboratories.

Another ERAB report is expected to be available later this month that studied and evaluated the technology transfer program at Doe and it laboratories and will recommendations on its improvement.

A preliminary draft of that study once again recommends "important changes can and should be made in the DOE's policies, practices and attitudes towards technology transfer and that the laboratories have a great potential to supply American industry with technology.

The reports states that "the panel feels that the issues of control and authority need to be reviewed and changed by DOE and the laboratories. While the panel understands that DOE and its field offices must ensure that the proper legal and regulatory practices are followed in the relationships between the laboratories and industrial partners, it finds that there is an unwarranted amount of caution, and management control exerted by the DOE. There is no doubt that care must be taken to prevent unreasonable use of government funds and property. However, a balance needs to be created towards more trust of the laboratory management and additional laboratory control and flexibility needs to be created so that the benefits from transferring technology can be realized to the greater benefit of the nation's economy.

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GARY G. ELLSWORTH, CHIEF COUNSEL FOR THE MINORITY

United States Senate
COMMITTEE ON
ENERGY AND NATURAL RESOURCES
WASHINGTON, DC 20510

September 26, 1988

The Honorable John S. Herrington
Secretary
U.S. Department of Energy
Washington, D.C. 20510

Dear Secretary Herrington:

On May 11, 1988 the Subcommittee on Energy Research and Development held a hearing on S. 1480 the "National Laboratory Cooperative Research Initiatives Act." Following the hearing the Subcommittee submitted questions for the record. As of today, we have yet to receive the answers to these questions. Since that time, the bill has been reported out of full committee. The staff has informed us they have been in contact with the program office at various times in the last three months. It is their understanding that the answers are in the process of being approved by the Office of Management and Budget.

I feel a sufficient amount of time has passed for your office to adequately respond to these questions. Therefore, we have decided to print the text of the hearing without the Department's responses.

Sincerely,

Wendell H. Ford
Chairman, Subcommittee on
Energy Research and Development

J. Bennett Johnston
Chairman

JBJ/tc

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JOHN H. GIBBONS
DIRECTOR

Congress of the United States
OFFICE OF TECHNOLOGY ASSESSMENT
WASHINGTON, DC 20510-8025

June 6, 1988

The Honorable Wendell H. Ford
Chairman, Subcommittee on Energy
Research and Development
Committee on Energy and Natural Resources
United States Senate
Washington, D.C. 20510-6150

Dear Mr. Chairman:

Enclosed are the answers to the questions which Senator Dominici asked, following submission of OTA's written testimony for the Subcommittee's hearing on S. 1480 held May 11th. I hope that these will be helpful to the Subcommittee and to Senator Dominici.

If you, other members of the Subcommittee, or the Subcommittee staff have further questions concerning OTA's Special Report on high-temperature superconductivity, your staff may contact me or the deputy project director, Wendell Fletcher. We can both be reached on 8-6340.

Sincerely,

John A. Alic
Senior Associate

Enclosure

RESPONSES TO QUESTIONS FROM SENATOR PETE V. DOMENICI

JOHN A. ALIC AND W. WENDELL FLETCHER

OFFICE OF TECHNOLOGY ASSESSMENT

Question 1: Would personnel exchanges as provided for in S.1480 be important in changing the "culture" at the laboratories?

Amendment 1627 to S.1480 would authorize the DOE national laboratories involved in the proposed Superconductor Research Initiative to undertake temporary exchanges of personnel with industry and universities. The culture of a laboratory in part reflects the work histories of its employees. Many of the scientists and engineers at national laboratories have little or no experience in industry. Personnel exchanges with industry could give laboratory personnel a hands-on appreciation of the kinds of problems industry faces in commercializing new technologies.

For personnel exchanges to alter the culture of the laboratories, it will not be enough for industry scientists and engineers to work for short periods of time at the national laboratories; laboratory personnel will have to work temporarily in the private sector. Indeed, a flow of people from the laboratories to industry could be the more important for bringing about fundamental change. OTA sees no reason to limit exchanges to programs involving cooperative R&D; the broader the exchange program, the more rapid and far-reaching the impacts would be.

DOE, for example, could establish fellowships for placing national laboratory personnel in temporary positions (6 months to two years) with private firms, where they would work on projects of interest to both the laboratory and the company. Sending 100 laboratory employees to industry each year should not cost the Government more than about $5 million per year (assuming that each placement would cost about $100,000 per year and that the laboratory and the company split the costs). The laboratory would also need to assure that time spent with industry on a fellowship would count toward pension eligibility.

The fellowship program could supplement DOE's existing program for personnel exchanges, which so far has been used primarily to bring industry scientists and engineers into the national laboratories. It would complement, not duplicate, the program of exchanges between Federal laboratories and the private sector under consideration by the President's Commission on Executive Exchange. This exchange program, called for by President Reagan in Executive Order 12591, has very limited resources at this time, and does not encompass contractor-operated laboratories.

Question 2. Could you elaborate on why technology transfer, personnel exchanges, and cooperative interactions with industry may be important in commercialization of high temperature superconductivity?

It will be up to industry to commercialize high-temperature superconductivity (HTS). Even so, judging from current spending patterns, the Federal Government may well pay for a half or more of all

U.S. R&D in HTS over the next several years. In FY 1988, Federal agencies will spend over $90 million on HTS R&D. While some will go to companies for contract R&D, most will go to Federal laboratories and the universities.

The national laboratories have limited experience in working with industry on commercial technologies. If the results of Federally-funded R&D are to be used quickly and effectively, then the barriers that have stood between the laboratories and industry must come down. Steps including personnel exchanges, better mechanisms for technology transfer, and cooperative R&D arrangements could help lower these barriers. By developing effective linkages with industry now, the national laboratories will be positioned to help U.S. firms commercialize HTS when applications begin to emerge.

Question 3. Why isn't U.S. industry doing more in superconductivity R&D? Can the national laboratories pick up some of the slack.

A number of large U.S. companies are putting substantial resources into HTS. So are a number of smaller firms with specialized expertise. However, many other U.S. firms with the technical and financial resources to pursue HTS have taken a wait-and-see attitude. Managers at these firms believe HTS should remain in the laboratory until more scientific knowledge is in hand. The financial criteria that drive decision-making in American corporations work against a technology like HTS -- one with uncertain prospects, and profits that appear to lie well in the future. Typically, the firms on the sidelines have a few people tracking progress in the field; some will be able to catch up when

applications begin to appear, but others will be left behind.

Because industry is not undertaking all the R&D that is needed, the burden will fall on the the national laboratories and universities. Unless they pick up some of the slack, the United States could fall behind the Japanese in HTS.

Question 4. Have you looked at strategies for using the laboratories to enhance economic competitiveness?

No. While this is a major issue for U.S. technology policy, it goes beyond the scope of OTA's Special Report on high-temperature superconductivity.

Question 5. Which provisions of S. 1480 are most important in accomplishing the goal of improving the national laboratories' ability to help industrial commercialization?

OTA has not been able to undertake an analysis of all the titles of S. 1480 or Amendment 1627. Of the provisions in Title I of Amendment 1627, which deals specifically with high-temperature superconductivity, the following should help in better integrating the laboratory system into the U.S. R&D infrastructure: (1) participation by private industry on the proposed "council for research on enabling technologies;" (2) giving directors of the national laboratories more discretionary authority to enter into cooperative agreements with industry; and (3) specific authorization for personnel exchanges. Provisions of this sort could in time improve the ability of the laboratories to help industrial commercialization.

Question 6. How would you rate the quality of superconductivity research in Japan's national laboratories and universities, compared to the United States?

Japan's R&D system is centered in its major corporations. Across science and technology as a whole, Japanese universities and national laboratories have neither the breadth nor the depth of their U.S. counterparts. In superconductivity, however, not only do company laboratories have excellent capabilites in technologies ranging from rotating machinery to Josephson junction computer chips, but so do a number of university and national laboratory research groups. Tokyo and Tohoku Universities, the Electrotechnical Laboroatory (operated by the Ministry of International Trade and Industry), and the National Research Institute for Metals (NRIM) have been especially prominent. NRIM scientists, for example, discovered the bismuth oxide HTS composition in January 1988.

The Japanese have been working in low-temperature superconductivity for years, in part because they have viewed it as important for energy conservation. This accounts in part for their excellent capabilities in the field. Japan also has excellent capabilities in a growing number of other fields of current importance for international competition, ranging from advanced ceramics to opto-electronics. A major effort to improve Japan's capabilities in basic research is underway.

Question 7. Could you compare the Japanese approach to commercializing high temperature superconductivity with that of the U.S.? What are the

strengths and weaknesses of each approach and what can we learn from the Japanese in their approach?

The general differences are these. Japanese industry puts more money into R&D, as a percentage of sales, than American industry. In Japan, Government pays for only a little over 20 percent of all R&D, while, in the United States, Government and industry each pay for about half. As a result, Japanese industry tends to be more self-sufficient in technology development. Japanese companies do work with universities and national laboratories, but much more of Japan's technology base is generated in the private sector. In particular, the United States depends more heavily on the university system.

The picture in HTS is consistent with these more general differences. With R&D centered in major corporations, government policies in Japan seek to strengthen the supporting parts of the infrastructure -- the universities and national laboratories -- which have typically been viewed as the weak links. Greater cooperation and interaction among all parts of the system are a major goal of policies in HTS. Leaders in industry and government see this technology as a test case for their turn toward basic research, and are giving it high priority.

Despite some press reports indicating the contrary, the Japanese Government has not established a highly centralized national program on HTS. Different agencies are pursuing their own programs, with differing goals and differing policy approaches. However, the hallmarks of the Japanese system -- e.g., continuity of research support over many years,

even in the absence of spectacular results, and the ability of government and industry to work out an R&D agenda in which the burdens are shared -- are already eveident. There seems little question that Japanese firms will be strong competitors in commercializing HTS, in part because of supportive government policies.

In the United States, where we have depended heavily on technologies flowing from military R&D (e.g., in the early years of the semiconductor industry), or university research (here biotechnology is a good example), events in HTS have again been consistent with the general picture. Rapid response to the breakthroughs in high-temperature materials, coupled with flexibility and good coordination at working levels, showed our own system to best advantage. Judging from other areas of technology, these strengths are greatest when it comes to support for science, and mission-oriented R&D in agencies like the Department of Defense (DoD).

But American industry seems to be spending less than Japanese industry, and DoD has about half of all Federal R&D money for HTS. Some of DoD's R&D will support commercialization of HTS, but the new realities of international competition mean that we may fall behind the Japanese unless industry itself plays a more active role. Even so, the Federal Government may have to support R&D in HTS for 5 to 10 years in order to create a technology base that can support commercialization by American firms.

Ora E. Smith
Director
External Technology Development

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Rockwell International

May 23, 1988 OS88.110

The Honorable Wendell H. Ford
Chairman, Subcommittee on Energy Research and Development
Committee on Energy and Natural Resources
United States Senate
Washington, D.C. 20510-5150

Dear Senator Ford:

It is my great pleasure to respond to Senator Domenici's questions which you sent to me on May 16 relative to S.1480 and proposed amendment No. 1627.

Question 1: In your dealings with the national laboratories what kinds of differences have you noticed in being able to work with defense program laboratories, versus working with the energy research laboratories?

Response: Our experience at Rockwell has been that when working with a defense program laboratory in its mission area our relationship has been very close and intense, and extremely beneficial to both parties. However, when attempting to work with a defense program laboratory in an area outside its primary mission area, or when working with an energy research laboratory which lacks the extremely clear charter of a defense program lab, it is much more difficult to define and pursue a mutually beneficial area of cooperative work.

The reason for this difference is not at all mysterious. The defense program labs have extremely well defined charters, and do an outstanding job of pursuing them. When it is in the interest of a DP lab to undertake a mission-related collaboration with industry, the objectives are always well defined, and the collaboration has the fullest support of the laboratory management. The energy research labs lack such clear missions, and I think are sometimes unsure as to what their real purposes are. Conse–

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quently, it is much more difficult to define and implement a joint program in an energy research lab. Cooperative projects with DP labs suffer from this same difficulty when they fall outside the mission area of the lab.

Question 2: What are the key problems at the DP labs, and to what extent does that inhibit your working with these labs?

Response: I really cannot define any major problems that typically occur when working cooperatively with a DP lab in a mission area; however, projects undertaken with a DP lab outside its mission area are definitely "second class citizens," with relatively little standing and only incidental support from management. It seems to me that the DP labs lack substantial incentive to engage in cooperative programs with industry outside their mission areas. I think it is for this reason that we have seen only limited transfer of technology outside the laboratories. I do not mean this to be a criticism of laboratory management in any way. They are doing exactly what the system is instructing them to do. I do not know for sure, but I strongly suspect that the DP laboratory manager who undertakes to "dilute" his mission work with unrelated cooperative activities with industry will be judged by bureaucratic standards to be misallocating his resources.

It seems to me that the balance of weapons work versus technology transfer work at the DP labs is a question which we need to reexamine given the competitive pressures on the U.S. and the enormous talent we have in our DP labs, most of which is completely inaccessible to U.S. commercial business.

Question 3: How do you think S. 1480 could correct the problems you see, if at all?

Response: S.1480 has the potential to correct the problems I see in the following ways:

1. By setting up several disciplinary areas in which the labs are specifically charged to work with industry (superconductivity, human genome, and semiconductor manufacturing) S.1480 effectively provides an incentive, previously missing, to work with industry. In effect the bill gives new missions to the labs. The result of these new missions should be to create incentives to work with industry that are comparable to the incentives that exist in the weapons mission areas.

Rockwell
International

2. By tightening laboratory control over patent protection and ownership S.1480 will tend to increase the value of the intellectual property that results from cooperative lab activities and increase the probability that jointly developed technology will be commercially exploited. The new patent provisions also create some financial incentives for laboratory management to seek joint research and exploitation of inventions.

3. By giving increased flexibility and autonomy to laboratory management, Title IV of S.1480, as amended, will allow laboratory management to become more creative and flexible in dealing with industry.

Question 4: What provisions of S. 1480 are most important for improving technology transfer from the laboratories?

Response: The most important provisions of S.1480 for improving technology transfer from the laboratories are these:

1. Title IV's grant of much improved flexibility and autonomy on the part of laboratory management to enter into cooperative agreements with industry.

2. Title IV's strengthened control over intellectual property will tend to increase its value.

3. Establishment of specific research areas (superconductivity, human genome, and semiconductor manufacturing) in Titles I-III will provide new missions for the labs and a framework for improved collaboration with industry. The personnel exchange provisions of these titles are extremely important. Industrial interactions with the labs will be vastly improved if personnel are regularly exchanged.

Many criticisms of S.1480 and its amendments have been made. We all want to avoid making mistakes; however, the only sure way to prevent a mistake is to take no action. S.1480 will probably generate unforseen consequences, some favorable and some not. I dare say this is true of any

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piece of legislation ever enacted. The time is long past when we in this country can afford to engage in endless debate about the possible adverse consequences of acting, especially when we are working in the field of international business competitiveness. We must be willing to tolerate an occasional mistake in order to make progress. There are undoubtedly risks in the bill, but I think they are minor risks compared the risks of inaction.

I hope my comments have been of service to the Senators and their staffs.

Respectfully submitted,

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